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Efficiency and equity dimensions of Primary Care: the consequences of a changing context

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Klára Dimitrovová

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Efficiency and equity dimensions of Primary Care: the consequences of a changing context

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Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it is the only thing that ever has.

Margaret Mead

List of publications

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Abstract

Background: Primary care is one of the key features for a sustainable, effective, and comprehensive health system, but its contribution depends on its strength. This dissertation evaluates (i) changes and inequalities in access to primary care in Europe and Portugal, and, (ii) how an important reform of the Portuguese model for providing primary care affected the use of inpatient and emergency care.

Methods: First, access to primary care in Europe was measured before (2007) and during (2012) the Great Recession; second, the evolution and financial cost of socioeconomic inequalities in access to primary care in Portugal were estimated from 2000 to 2014; third, the effect of different organizational models of primary care provision on all emergency department visits in Portugal between 2013 and 2015 was measured; and last, the impact of the Portuguese primary care reform on ambulatory care sensitive conditions (ACSC) and on disease specific ACSC related to health conditions targeted in the pay-for-performance were measured from 2000 to 2015.

Results: Results show that access to primary care improved during the Great Recession in Europe and that this improvement was greater for people living in countries with higher investment in health. However, socioeconomic inequalities in access to primary care persisted in this period. In Portugal, there are significant and increasing socioeconomic inequalities in ACSC, which possibly reflect inequalities in access and continuity of care in primary care. People assigned to the new organizational model of primary care provision (Family Health Units) had a lower emergency department utilization. Nevertheless, the Family Health Units did not have an impact on the reduction of ACSC, nor on the rate of disease specific ACSC related to health conditions targeted in the pay-for-performance.

Conclusion: Supportive health policies for stronger primary care are essential to guarantee access to primary care during economic recession periods, however more attention should be given to the reduction of socioeconomic inequalities in access to primary care. Also, in Portugal there are significant and increasing socioeconomic inequalities in access to primary care. The current primary care reform may have enhanced the asymmetries in the access and quality of services provided at this level, and the capacity of the pay-for-performance mechanism in achieving better health outcomes is questionable.

Key words: Primary care; Great Recession; reform; access; inequalities, pay-for-performance.

Resumo

Enquadramento: Os cuidados de saúde primários representam um setor essencial para um sistema de saúde sustentável, eficaz e abrangente, sendo que estas contribuições dependem muito da própria estrutura deste nível de cuidados. Esta tese pretende (i) avaliar as mudanças e desigualdades no acesso aos cuidados de saúde primários na Europa e em Portugal e, (ii) avaliar como uma importante reforma do modelo de prestação de cuidados de saúde primários em Portugal alterou a utilização de cuidados de saúde hospitalares, nomeadamente episódios de internamento e idas aos serviços de urgência.

Métodos: Em primeiro lugar, o acesso aos cuidados de saúde primários na Europa foi medido antes (2007) e durante (2012) a Grande Recessão; em segundo lugar, a evolução e o custo financeiro das desigualdades socioeconómicas no acesso aos cuidados de saúde primários em Portugal foram estimados de 2000 a 2014; em terceiro lugar, o efeito de diferentes modelos organizacionais de prestação de cuidados de saúde primários em todos os episódios de urgências foi medido em Portugal entre 2013 e 2015. Por último, foi medido o impacto da reforma portuguesa dos cuidados de saúde primários nos internamentos evitáveis e em grupos de doenças específicas de internamentos evitáveis relacionados com as condições de saúde sobre incluídas no modelo de pagamento por desempenho, entre 2000 e 2015.

Resultados: Os resultados indicam que o acesso aos cuidados de saúde primários na Europa melhorou durante a Grande Recessão, e que esta melhoria foi maior para as pessoas que vivem em países com maior investimento em saúde. No entanto, as desigualdades socioeconómicas no acesso aos cuidados de saúde primários persistiram neste período. Em Portugal, existem desigualdades socioeconómicas significativas e crescentes nos internamentos evitáveis (i.e. Internamentos por Causas Sensíveis a Cuidados de Ambulatório) que refletem possivelmente as desigualdades no acesso e na continuidade dos cuidados de saúde primários. As pessoas inscritas no novo modelo organizacional de prestação de cuidados de saúde primários (Unidades de Saúde Familiar) têm uma utilização menor dos serviços de urgências hospitalares. No entanto, as Unidades de Saúde Familiar não tiveram impacto na redução dos internamentos evitáveis nem nos grupos de doenças específicas de internamentos evitáveis relacionadas com as condições de saúde incluídas no modelo de pagamento por desempenho.

Conclusão: Políticas de saúde para o reforço dos cuidados de saúde primários são essenciais para garantir o acesso aos cuidados de saúde primários durante os períodos de recessão económica, no entanto, mais ênfase deve ser dada à redução das desigualdades socioeconómicas no acesso a este tipo de cuidados. Também em Portugal, existem desigualdades socioeconómicas no acesso aos cuidados de saúde primários, que têm vindo a aumentar ao longo do tempo. A atual reforma dos cuidados de saúde primários pode ter aumentado as assimetrias no acesso e na qualidade dos serviços prestados neste nível, e a capacidade do mecanismo de pagamento por desempenho em alcançar melhores resultados em saúde é questionável.

Palavras-chave: Cuidados de saúde primários; Grande Recessão; reforma; acesso; desigualdades, pagamento pelo desempenho.

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List of abbreviations

ACSC	Ambulatory Care Sensitive Conditions
COPD	Chronic Obstructive Pulmonary Disease
FHU	Family Health Units
FHU-A	Family Health Units model A
FHU-B	Family Health Units model B
GDP	Gross Domestic Product
ICD-9-CM	International Classification of Diseases 9th Revision Clinical Modification
NHS	National Health Service
OECD	Organisation for Economic Co-operation and Development
OR	Odds Ratio
PHCU	Personalized Health Care Units
PQI	Prevention Quality Indicators

Foreword

Primary care is one of the key features for a sustainable, effective, and efficient health system. The importance of primary care has long been recognized globally, and thus European countries, including Portugal, have been investing in this level of care and implementing supportive governmental health policies to strengthen it. Despite the literature on the positive effects of an effective and high-quality primary care system, there is still a gap in our knowledge regarding the contribution of several determinants for its effectiveness. Additionally, the continuous changes in demographics and morbidity, the increase of migration flows and of socioeconomic inequalities, and the need to rationalize service delivery in a context of limited public budgets, present serious challenges to the sustainability of health systems. Accordingly, the present doctoral dissertation seeks to contribute to a better understanding about the effectiveness of the changes in primary care motivated by the Great Recession and the Portuguese primary care reform.

This dissertation has six chapters, organized as follows: the first chapter comprises the theoretical background for the present research, in which some main aspects of primary care are highlighted, namely the importance of primary care for better population health, the recent trends, reforms, and unmet challenges of primary care in Europe, and the current Portuguese primary care reform. Additionally, the core dimensions of a strong primary care and its determinants are presented and the main measures for the evaluation of primary care are enumerated. The second chapter is dedicated to the research hypotheses and objectives of this thesis. The third chapter presents some methodological aspects, including the data sources. The variables and statistical analyses used throughout the dissertation are briefly enumerated and further explained in each paper included in the next chapter. The fourth chapter is dedicated to results, organized in two sections. The first section is dedicated to an extensive analysis of the changes and inequalities in access to primary care in Europe and Portugal; and the second section is dedicated to an extensive analysis of the impact of the Portuguese primary care reform on secondary care use. Each section has two papers. The fifth chapter is dedicated to the discussion of the main results and to the main strengths and limitations of this dissertation. Additionally, further investigations are presented. The sixth and final chapter is dedicated to concluding remarks and policy implications.

1. Theoretical background

1.1. Importance of primary care

The importance of primary care was acknowledged in the 1970´s with the declaration of Alma-Ata (1978)[3] and with the release of the report "*A Manpower Policy for Primary Health Care: Report of a Study"* by the Institute of Medicine, also in 1978.[4] Later on, in 1996 the Institute of Medicine defined primary care as "the provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community".[5] Since then, primary care has been encouraged as an essential sector for a sustainable, effective and comprehensive health system.

In 2005, Starfield, Shi and Macinko, collected a large body of evidence, including several systematic reviews, which show that an adequate and high-quality primary care system (i.e. a strong primary care system) is a key factor for an effective and efficient health system, and that health policies that strengthen primary care are associated with better levels of population health, with a more equitable distribution of health in the population, and with lower overall costs of health services.[6]

Specifically, first they showed that population health outcomes are better in areas with a greater supply of primary care physicians, even after controlling for sociodemographic and lifestyle factors. These health outcomes included lower rates of total and cause-specific mortality (heart disease, cancer, or stroke), infant mortality, low birth weight and poor self-reported health. Second, they argued that people who receive care from a regular primary care physician are healthier, due to the positive impact of people´s relationships with their physician. Third, the authors showed that primary care is inherently a more equitable level of care provision than any other, since it is less costly and more easily available for the patient, and focuses on the early detection and prevention of the progression of the disease. Thus, it is more likely to have a considerable impact in reducing disparities[1] in the severity

[1] Disparity in health is defined as a particular type of health difference that is closely linked with economic, social, or environmental disadvantage.[198] Paula Braveman (2014) argues that health disparities can be used to measure progress toward achieving health equity: "Moving toward greater equity is achieved by selectively improving the health of those who are economically/socially disadvantaged, not by a worsening of the health of those in advantaged groups."[199]

of illness, which is essential to narrow disparities in health between the more and less socially deprived groups of population.[7,8]

Finally, Starfield, Shi and Macinko (2005) showed that people with no source of primary care are less likely to receive preventive care and more likely to delay seeking needed care leading to a higher likelihood of being hospitalized or to receive care in emergency departments, at higher costs.[6,9]

More recent studies also indicate that people living in countries with a strong primary care system have better health outcomes, lower rates of unnecessary hospitalizations and relatively lower socioeconomic inequalities[2] in self-assessed health[10,11] and in unmet health care needs.[12] Additionally, Detollenaere et al. (2018) argues that a strong primary care system can buffer the inverse association between income inequality and health.[13]

Even though Kringos et al (2013) showed that European countries with a strong primary care system have higher total health care expenditures, they also showed that these countries have a slower growth in health care expenditures, suggesting that they are able to better control costs. This opportunity for cost containment as well as other positive effects of a strong primary care system such as better quality of care have also been documented by Groenewegen et al. (2013).[14]

Therefore, it is no surprise that health policies that strengthen primary care, as well as overall recommendations for more investment in this level of care have been continuously encouraged by academics and policy makers worldwide. An adequate delivery of primary care must be associated with supportive governmental policies and structural changes, such as an equitable distribution of resources across the country and low or no patient cost sharing.

1.2. Recent trends and reforms of primary care in Europe

Health care systems worldwide face several challenges due to demographic and socioeconomic changes and subsequent increase in populations´ health needs. Along with longer life expectancy, the complexity of the health problems due to the co-occurrence of multiple chronic diseases (or multimorbidity) is greater. Also, persisting socioeconomic

[2] Inequality in health is defined as a health difference that is avoidable, unnecessary, and unjust.[200] Health inequalities is the term used in most countries, especially in European Countries, and is generally assumed to refer to socioeconomic differences in health. In the public health community, social inequalities in health are used with the connotation of health inequities and carry the same connotation as health differences that are avoidable, unfair, and unjust. Some European languages even have only one word for inequity and inequality and there is no distinction between the two terms.[200] In this dissertation inequalities are also used with the connotation of health inequities.

inequalities and migration flows are also contributing to an increase in inequalities in health and access to health care.[14,15] These changing patterns require a coordinated health system response to deal with the health needs of the population, making the primary care system a focal point for improvement.[14,15]

There is considerable variation in the organization, composition, policy initiatives, and overall strength of primary care among European countries, which differ essentially according to wealth, governments´ political composition, differences in the historical context, and prevailing cultural values, as well as to the type of the health care systems.[14–16] Countries with a National Health Service (NHS) and/or that have been governed by a predominantly social democrat government, tend to have stronger primary care systems, and wealthier countries tend to have weaker and less accessible primary care compared to less wealthy countries.[16,17] For example, countries of Central and Eastern Europe, such as Estonia and Lithuania, that belonged to the former Soviet Union and then joined the European Union, have undergone major health care reforms and are the ones that have shown the strongest improvement in primary care. Their hospital oriented health systems (with overall low governmental investment and priority) were transformed, and strategies that emphasized primary care were introduced, such as the introduction of family medicine, gatekeeping, and remuneration of general practitioners based on capitation, and quality related bonuses, leading to a better chronic disease management and a higher patient satisfaction with primary care.[10,14] On the other hand, in the former Soviet Union countries that did not join the European Union, such as Belarus, have shown a much slower reform process of their former health care system, and no fundamental changes have yet been made. Primary care is still organized in a small and fragmented way, there is no gatekeeping, and access to hospitals remains relatively easy.[10,14]

Other Western European countries, such as Belgium, France, and Germany, with Bismarckian health care systems (i.e. social health insurance systems), and with "traditionally weak primary care" have also made modest steps toward a stronger primary care system, and their reforms have been more limited. In these countries the health systems have a strong emphasis on freedom of choice (both in primary care and specialist care), including the absence of any gatekeeping and demand restrictions via co-payments. Primary care has been essentially characterized by small scale organizations with predominantly single-handed practices of primary care physicians, with little support or coordination with other healthcare professionals. Nevertheless, some policy changes have been implemented to strengthen primary care, such as the introduction of incentives for both

patients and general practitioners. On one hand, the patients have lower co-payments for primary care and higher reimbursement of costs of specialist care when referred by their general practitioner, and on the other hand the general practitioners have been increasingly paid by capitation, meaning that they receive a fixed fee per patient who registers with them on a voluntary basis.[10,14]

Countries with an NHS type health care system, such as the United Kingdom, Portugal, and Spain, are characterized by "traditionally strong primary care". Actually, their overall primary care strength has remained relatively constant over time, while there have been some improvements in Portugal.[10] In these countries there is also a fully enforced gatekeeping system and access to primary care is guaranteed by universal coverage. General practitioners have a financial status comparable to medical specialists, as opposed to the countries in Eastern Europe, and the provision of care consists usually of multidisciplinary teams. Primary care is the basis for the health care system and is largely regulated by the state, and by some regional decentralized authorities. In the United Kingdom the primary care professionals are also often accountable for the management of some health resources, and the pre-eminence of general practice is firmly established.[10,18] Reforms in the primary care system have been partial, as compared to the former communist countries, and focused essentially on the introduction of pay-for-performance schemes for quality improvement. Currently, the Quality and Outcomes Framework in the United Kingdom (implemented at the national level in 2004) is the largest pay-for-performance scheme ever implemented in primary care worldwide.[19,20]

Nevertheless, despite these historical differences, there is a significant level of consistency in the main policy interventions in the primary care reforms among European countries. There is a general commitment to ensure universal access to primary care services and the pre-eminence of general practitioners as the key focal point in primary care provision and coordination of care.[10] Increasing the hours of service, creating or expanding the availability of urgent primary care services, establishing general practitioner home visits, and improving the coordination of primary care and emergency care are some of the measures adopted in many European countries.[21] Also, there is an aim to keep co-payments for primary care low, and in most countries primary care is the preferred entry to the health care system. Some countries have even created exceptions for co-payments to enhance access to primary care for the most socioeconomically disadvantaged population.[10] These reforms seemed to have been even stronger during the Great Recession, since primary care received funding priorities.[22,23]

Regardless of the ongoing efforts to promote primary care in many European countries, some common challenges persist, essentially related to the structural sustainability of primary care and to the potential shortage of health professionals at this level of care. Various countries already have or are expected to have a shortage of general practitioners in the near future, mainly because of ageing and due to the inability to attract enough young medical students into general practice. Creating more team-based practices in primary care as opposed to single-handed practices could help in the recruitment of medical students to become general practitioners,[10] since these practices are linked to increased job satisfaction.[24] The income of primary care providers is also substantially lower than the income of medical specialists in Eastern Europe, which still limits the professional status of primary care providers and reduces the attractiveness for young health professionals.[10] The shortages of general practitioners usually arise first in the most deprived and rural areas, creating a risk in the equitable access to primary care for this population. The introduction of performance-related financial incentives, associated with other payment mechanism such as salary of capitation, to influence physician behavior, is now also a common challenge due to its contradictory effectiveness and possible unintended consequences.[25]

1.2.1. The Portuguese primary care reform

Portugal has an NHS (*Serviço Nacional de Saúde - SNS)* with a strong gatekeeping system. Since 1970 primary care has traditionally been provided in primary care centers, in which general practitioners worked in solo practice and were paid fixed salaries.

In 2006 a primary care reform was initiated in order to increase the number of persons registered in primary care, to promote teamwork among health professionals, and to pursue a differentiated payment mechanism linked to performance.[26] The main goals of the reform were to strengthen primary care by improving access, increasing satisfaction for professionals and for users, improving quality and continuity of care, and ultimately improving efficiency.[18,27] The organization of primary care centers was redefined, and several models of primary care provision were created.[27]

The most significant aspect of the reform was the creation of Family Health Units (FHU) *(Unidades de Saúde Familiar - USF),* which consisted of voluntarily constituted multidisciplinary teams of 20 health professionals on average (general practitioners, nurses, and administrative technicians), enjoying functional and technical autonomy, and partly financed through capitation and pay-for-performance. This pay-for-performance scheme is based on a series of performance indicators, mainly related to child and maternal health,

cancer screening, vaccination, and diabetes and hypertension management,[28] and can take the form of team-based institutional incentives or individual financial incentives, which depend on the achievement of specific incentivized performance indicators. There are two models of FHU: model A and model B. All FHUs start as model A and must prove a specific level of quality, including clinical and functional targets, before they are allowed to apply for transition to model B. Both models have team-based institutional incentives that correspond to monetary incentives but can only be used, for example, for the development of key infrastructure, purchase of equipment, or for the completion of specific professional training. These incentives are attributed every year by the five Regional Health Administrations of mainland Portugal.[29]

Additionally, in FHU model B, there are individual financial incentives for all staff (supplementary payments) that are a variable component of the remuneration process (the rest is a fixed legislated salary). These incentives can reach up to 30% of total physician remuneration and up to 10% for nurses, and are attributed every year by the Portuguese Central Administration of the Health System.[27]

All patients covered by FHU are entitled to a designated general practitioner named “family physician”, which should allow a better access and better continuity of care due to the longer-term relationship with the patient, as previously mentioned. Quality was also expected to be enhanced by the multidisciplinary nature of the practice, its longer opening hours, and possibility to schedule visits more easily. This new provision model was expected to ultimately contribute to better health outcomes through better prevention and follow-up, as well as reduced use of secondary care.[27]

Since 2006 there has been a progressive expansion of FHU across Portugal, which because it was based on voluntary decisions, was unrelated to any specific geographic criterion or population needs assessment. Consequently, the population started to be covered or not by a FHU depending on whether or not a new FHU was created in their area of residence. Also, since 2006 the term “primary care center” has been discontinued and the health professionals that did not join the FHU model have become part of the Personalized Health Care Units (PHCU) (*Unidades de Cuidados de Saúde Personalizados - UCSP)* with new contracting arrangements, but which differ from FHU in staff size, facilities, and payment mechanisms (without pay-for-performance).[27]

FHU are often seen as the result of a significant innovation and apparently a highly successful primary care reform,[26] and some available data suggest that these units are performing better than the PHCU in the quality of care delivered, as measured by

improvement in the processes of care (e.g. “blood pressure checks” and “diabetes checks”).[28] However, so far no study has investigated the impact of the FHU on secondary care use or patient health outcomes.

At the end of 2018 there were 528 FHU across 140 municipalities and there were 138 municipalities without any FHU. Additionally, at the beginning of 2019 full coverage of the Portuguese population by a general practitioner still did not exist, and 707,283 persons (6.97% of the people registered in primary care) had no general practitioner.[30] All of these patients were assigned to the PHCU. This current way of primary care organization possibly causes many asymmetries in access and reinforces the asymmetries in the quality of services provided, raising major concerns regarding the inequalities induced in the provision of primary care. In fact, there is strong evidence of health inequalities in Portugal, possibly among the highest across European countries.[31]

1.3. The core dimensions and strength of a primary care system

As mentioned previously, strong primary care is one of the key features for a sustainable, effective, and efficient health system.[32] Despite some differences in the definition of what constitutes primary care and how it should be organized, there is general consensus in the literature regarding the core dimensions that a strong and high-quality primary care system should have in order to achieve better health outcomes for the population.[17,33,34]

These core dimensions, which represent the process of care, were first defined by Barbara Starfield in 1979,[33,34] and are the following: access (i.e. the primary care system has to be accessible for all people and must represent the first contact of care and entry into the health system), continuity of care (i.e. the primary care system must provide person-focused rather than disease-focused continuity of care over time), coordination (i.e. the primary care system must provide coordination of care services across all health care levels), and comprehensiveness (i.e. the primary care system has to be comprehensive to the needs of the population in terms of providing a wide range of appropriate services).

Additionally, Kringos et al. (2010) defined three dimensions of primary care, related to outcomes: quality of care, equity,[3] and efficiency.[35] The quality of care is reflected in the degree to which primary care services meet the needs of patients and standards of care,

[3] Paula Braveman defines health equity as “the principle underlying a commitment to reduce - and, ultimately, eliminate - disparities in health and in its determinants, including social determinants. Pursuing health equity means striving for the highest possible standard of health for all people and giving special attention to the needs of those at greatest risk of poor health, based on social conditions (…) Health equity means social justice in health”.[199]

and depends on the preventive care, on the prescribing behavior of providers, and on the quality of diagnosis and treatment in primary care, including the quality of management of chronic diseases, mental care, and maternal and child health care. In the context of primary care, Kringos et al. (2010)[35] defined equity in health as the absence of systematic and potentially remediable differences in health status across population groups and is reflected in the level of disparity of primary care sensitive health outcomes across population groups. Finally, efficiency of primary care is the level of resources of the health system that are used to treat patients in order to achieve certain outcomes.[35]

Several studies have focused on the contribution of the core dimensions of primary care to its overall strength and effectiveness, and consequently, on the dimensions' impact on health outcomes. For example, Macinko, Starfield, and Shi (2003) assessed their contribution in a variety of health outcomes in 18 Organisation for Economic Co-operation and Development (OECD) countries between 1970 and 1998, by ranking each of the countries' primary care systems, using 10 indicators.[36] More recently, in an extensive project entitled Primary Health Care Activity Monitor for Europe, Kringos et al. (2010) developed a Primary Care Monitoring System in which they ranked the primary care systems of 31 European countries in the core dimensions (process of care, outcomes, and in other areas related to the governance, economic conditions, and workforce of the primary care system i.e. structure), using 99 indicators.[11,17,35] With this "Primary care Monitor", the authors created a basis for routine data collection that provides reliable and comparable information among primary care systems of European countries, and should serve the needs of various stakeholders to improve the effectiveness of primary care over time.[17] Even though the results of these studies are clear and allow for comparison across countries, showing that stronger primary care systems are linked to better population health, the model´s complexity and extensive data collection can make its application difficult when the aim is, for instance, to measure the evolution and/or changes over time in the primary care system of a specific country, or to perform an extensive longitudinal analysis.

1.4. Determinants of the core dimensions of primary care

Notwithstanding the primary care system framework developed by Kringos et al. (2010), [11,17,35] it is possible to look at the determinants of the core dimensions of process of care (i.e. access, continuity of care, coordination, and comprehensiveness) differently. Indeed, not only do the structural characteristics of the health system influence the process of care, but individual characteristics (patient characteristics) also play a significant role. For the purpose

of this dissertation, the determinants of the core dimensions of primary care are divided as follows: the contextual characteristics, health system characteristics, and individual characteristics.

1.4.1. Contextual characteristics

The contextual characteristics are the broad political, economic, and social conditions, as well as the basic infrastructures at a country/regional level. Health Policies, especially at a national level, may determine the vision and direction of a primary care system, through priority setting, management, and governmental integration programs of different levels of care provision.[35] Government involvement in primary care provision (such as the regulation and distribution of human resources across geographical areas, assuring universal financial coverage for primary care services, and the ownership of primary care practices) can influence the overall availability and accessibility to primary care.[35] Specifically, supportive governmental policies such as an equitable distribution of primary care services, limiting patient cost sharing for primary care services, and stronger gatekeeping systems have been shown to have a positive influence in access, including equity in access, continuity, and coordination of care.[6,16] Countries traditionally governed by left-wing governments implement more primary care supportive polices and invest more in the workforce development, leading to a stronger primary care system and consequently to better accessibility and coordination of primary care.[16]

The economic conditions, such as the gross domestic product, the total health care expenditures, the total expenditures on primary care, and the health care funding system (taxes, social health insurance of private health insurance), can also influence the core dimensions of primary care and consequently the provision of this level of care.[35] In Europe wealthier countries tend to have weaker primary care accessibility, probably because of their funding arrangements toward more expensive specialized care to satisfy public expectations. However, in Eastern European countries with a transitional health system, the growth in wealth has improved both accessibility to primary care and continuity of care by increasing the availability of primary care services.[16] Other indicators also related to economic conditions such as working conditions and employment status of primary care professionals, measured by their income as compared to other medical specialists, can also influence primary care provision. At a regional level, for example, lower overall investment in health services including primary care in lower-income areas is likely to occur, leading to lower quality of health services. Consequently, people from these areas may not only face

a shortage of primary care physicians, they may have fewer referrals to specialist consultations, leading to a lower coordination of care and to a delay in care.[37]

The social conditions such as the comprehensiveness of the Social Security System of a country in areas such as retirement, unemployment, disability, and sickness benefits programs, as well as the social resources that include community resources, social network, and social support are also important contextual determinates in the core dimensions of primary care. For example, higher rates of unnecessary hospitalizations for social reasons are more likely to occur in areas where there is a non-response or lack of coordination of health services with social services.[38] The social conditions are often grouped together with economic conditions into a composite measure as socioeconomic conditions.[36] People who often have lower social support are also more likely to experience material and financial deprivation. Finally, infrastructures such as roads and transportation systems can greatly influence access to health services including to primary care. Again, a lower availability of transportation systems and greater distances to primary care facilities are more likely to occur in more socioeconomically disadvantaged areas.[39]

1.4.2. The health system characteristics

The type of health care system, which influences the strength of the primary care, is closely related to the contextual characteristics mentioned above. In Europe, countries with social security-based systems (mostly countries in Eastern Europe) are usually associated with lower accessibility to primary care, and countries with an NHS and countries with a transitional health care system (mostly former communist countries) are associated with greater accessibility and better continuity of care in primary care.[16] Notwithstanding the type of health care system, there are specific health system characteristics that influence the core dimensions of primary care: the supply of primary care physicians (usually measured as the rate of primary care physicians per population); the geographical accessibility (i.e. the distance to facilities); the organizational features of primary care, such as the existence of an appointment system, after-hours care arrangement and home visits; and the financial accessibility such as co-payments, can influence its accessibility, and consequently quality and efficiency.[6,17]

Primary care systems in which people have a designated general practitioner as regular source of care are crucial for continuity of care, since these imply having a long-term relationship with the provider, who is responsible for the patient´s overall health and health care. Having previous knowledge of a patient increases the physicians´ ability to recognize

psychosocial problems influencing the patient's health and can contribute to effective management of a chronic condition and better medication adherence, enabling the development of long-term disease monitoring. Ultimately this allows for better quality of care and an early management of health problems in order to reduce unnecessary secondary care.[10,40,41]

The presence of a gatekeeping system, practice structure (single-handed practices *vs*. teams), and the overall integration and collaboration of primary care with secondary care and with other institutions in the public health sector, can also influence coordination of care.[33,42] The physician´s and other health professional´s own ability to integrate all aspects of care are also essential for the adequate use of the services within primary care, as well as in all other levels of care in order to ensure that patients are adequately referred and guided through the health system. The lack of coordination with, for example, secondary care, and the lack of sharing information about diagnostic services between general practitioners and other medical specialists can lead to duplication of services and unnecessary costs.[6,10] Other health system characteristics such as the availability of diagnostic services and medical equipment can have an impact on the comprehensiveness of care, since the broader the primary care services are, the stronger the primary care is, and the less is the dependency on secondary care use.[6,10]

Finally, the physician´s payment mechanisms can also influence their preventive, diagnostic, and evidence-based treatment decisions and behavior, and consequently have an influence on the amount, type, and location of care received by patients, especially in health systems where they act as gatekeepers. These decisions include the prescription of medication and diagnostic tests and the decision about follow-up treatment and/or referral to specialist care or to another health professional.[43] Consequently, payment mechanism (i.e., financial incentives) have been used to influence general practitioners' behavior, with the ultimate goal of improving patient health outcomes at reduced costs. The financial incentives are an extrinsic source of motivation and are used when a monetary transfer is conditional on acting in a particular way, as opposed to the intrinsic sources of motivation of health professionals, which include the likelihood that patients' health will improve as a result of a course of action, and motivation from performing a task well.[44]

Financial incentives can be divided into four main categories: salary, capitation, fee-for-service, and target payments and bonuses, also known as pay-for-performance.[43,44] These payments are expected to have different effects on behavior, and/or to provide different opportunities to influence behavior.[45] Regarding pay-for-performance, the payment depends

on the meeting of a certain pre-specified performance measure (or on the provision of a pre-specified level of change in a performance measure), usually associated with process of care. In this payment general practitioners have the incentive to reach the pre-defined targets. Therefore, in theory, on one hand these pay-for-performance programs should help drive the behavior of health care providers to improve the quality of care delivered and consequently to improve patient health outcomes and reduce unnecessary use of more expensive health care services.[46] On the other hand, there are some concerns about the unintended consequences of this type of payment, such us avoidance of high-risk patients, cheating, and the undermining of professionals´ intrinsic motivation to provide high-quality care.[44,47]

1.4.3. Individual characteristics

The individual characteristics of the patient such as health literacy, socioeconomic status, and behavior are also determinant for an adequate process of care. This means that the access and utilization of primary care services will not only depend on the availability, accessibility, and affordability of services (among others), but will also be determined by individual features such as health needs (or perceived health needs), the decision to seek care, the actual utilization of health services, and finally by the treatment compliance.[48–50]

This means that an individual will have a given propensity to visit (or not) a primary care physician according to her/his self-perceived needs, and may delay seeking care despite having adequate access to primary care.[49] This perception of need can be influenced by patients' perceptions of the benefits and quality of care, their attitudes, beliefs, and expectations.[50] Only after the patient´s recognition of her/his needs for health services is the decision to seek care made. Patients with low income may especially delay the search for needed medical care or medications due to financial constraints, which may include transportation costs and health care co-payments.[10,51,52] There is also an important cost for the patient that results from the time lost from work in traveling to the health services plus the actual time spent in the consultation. This opportunity-cost may affect different socioeconomic groups in different ways.[49]

Moreover, the availability of primary care does not necessarily mean that all people will preferably use these services as a first contact with the health system, despite having good access. The acceptability of primary care services, which includes the past experiences and satisfaction with the organization of primary care, will also contribute to the actual utilization of these services.[35]

The use of health services is also influenced by the actual ability to use the service. Therefore, people may have access to care and decide to seek care, but then encounter difficulties in utilizing the services. For example, low-educated people may lack awareness and knowledge of the overall health system, including the main attributes and health services provided in primary care, and have difficulties in navigating within the system.[10,51,52]

In addition, other vulnerable groups, such as low-income migrants, may face language and cultural barriers in accessing primary care, even if they live in a specific geographic area with a high primary care physician supply.[53]

Finally, an adequate process of care in primary care will occur only if the patient ultimately adheres to the treatment and follows the physician´s recommendations. For example, the individual's socioeconomic status may influence continuity of care, since an understanding of physicians' recommendations and treatment compliance are essential. Also, patients with lower health literacy may be less prone to adopt self-management behaviors since they may have a poorer understanding of how the disease affects their life, of how to cope with the symptoms, and of how to maintain good control throughout the course of the disease.[49,52,54]

1.5. Outcomes of a strong and effective primary care system

A strong primary care system is effective in the sense that it contributes to the achievement of better population health outcomes. Some of the health indicators that have been shown to be related to stronger primary care are lower total and cause-specific mortality (heart disease, cancer, or stroke), infant mortality, low birth weight, poor self-reported health,[6] and unmet health care needs.[12] Other indicators that reflect both health outcomes as well as secondary care use, such as hospitalizations for Ambulatory Care Sensitive Conditions (ACSC) and emergency department visits have also been used to measure the strength of a primary care system. In fact, in the case of ACSC, they have been spread worldwide as an indirect measure of the overall effectiveness of a primary care system. Nevertheless, it is important to note that these indicators have been found to be more closely related to two of the core dimensions of process of care: access and continuity of care, than to any other organizational characteristics of primary care, such as coordination of care and comprehensiveness. Additionally, self-report has also been used to estimate health care utilization and access to primary care.[55]

1.5.1. Ambulatory Care Sensitive Conditions

ACSC are the most widely used indirect measures of a strong and effective primary care system. Since the study by Billings et al. (1993),[53] ACSC have been updated and validated in several countries.[56–58] ACSC are defined as specific conditions for which hospitalization is potentially avoidable through patient education, health promotion initiatives, early diagnosis, early treatment, and by appropriate chronic disease management, i.e., by "timely and effective primary care".[59] This does not mean that hospital admissions for ACSC are inappropriate at the moment of inpatient admission, but that the lack of an early and regular primary care intervention leads to an avoidable progression and exacerbation of the health condition that ultimately will require a hospitalization. For example, in the case of diabetes type II, adequate treatment and change in lifestyle should avoid hospitalization.

A systematic review by Van Loenen et al. (2014) showed a strong association between ACSC and an accessible and continuous primary care system.[42] Insufficient primary care physician supply (i.e. number of primary care physicians per population), and a lower diffusion of primary care were found to be negatively associated with ACSC.[42,60] This association was found in countries with different health systems, namely more private-oriented health systems, such as in the United States,[60,61] and more public-oriented ones, such as those in Australia,[62] Canada,[63] and United Kingdom.[64] These results are supported by another systematic review by Gibson et al. (2013) on the association between hospitalization for diabetes-related ACSC and primary care resourcing. The authors also showed that more primary care physicians per capita are significantly associated with lower rates of diabetes-related ACSC.[65] The influence of continuity of care on ACSC is also reported in several studies.[41,42,66] Regarding coordination of care, comprehensiveness, and other organizational characteristics of primary care, such as the primary care physician's list size,[37,49,67,68] practice type (single-handed practices *vs*. teams),[69,70] and having access to ancillary or support services,[69] showed no association or mixed results with ACSC.[42]

Considerable research efforts have also assessed the relationship between individual and contextual socioeconomic characteristics and ACSC. Studies have found a strong socioeconomic gradient in the rates of ACSC, showing that people from low-income areas, living in rural and/or more deprived areas, and from areas with higher proportions of uneducated people, have a much higher risk of being hospitalized for these conditions, after controlling for primary care characteristics such as primary care physician supply. As a result, many authors even suggest that ACSC are more closely related to socioeconomic characteristics than to the quality of primary care.[39,49,76,77,54,62,63,71–75]

1.5.2. Emergency department visits

Regarding emergency department visits, the evidence about the strength of a primary care system on the reduction of these visits is not as consistent as in the case of ACSC, with some authors claiming that it remains insufficient,[78] since the research on this topic has often been poorly designed (e.g. studies without proper adjustments for variables including sex and socioeconomic status or studies using observation periods of insufficient length to adequately evaluate intervention impact).[79] Nevertheless, it has been proposed that some emergency visits are indicative of inadequate access to primary care and poor continuity of care.[79,80] A recent fully controlled large-scale natural experiment, performed by Whittaker et al. (2016), showed that increasing access to primary care was associated with lower emergency department utilization.[80] Other studies also suggest that extended access to primary care that is achieved by enhanced service hours, [81–83] better continuity of care, [84–86] or the ability to make an appointment with a particular general practitioner was associated with a lower number of emergency department visits.[87,88] To the contrary, in a systematic review, Ismail et al. (2013) reinforced the idea of inappropriate patients' health seeking behavior for non-urgent problems as the main reason for inadequate emergency department utilization.[89]

1.5.3. Self-reported utilization of health care services

Self-reporting obtained through direct questioning of the individual is one of the most widely used methods of collecting information regarding individuals´ health status, health behaviors, and utilization of health care services, despite some potential biases.[90] These subjective assessments are mostly used to evaluate the extent of inequity in health, access to, and use of health care services since they are less expensive and less time-consuming than collecting extensive data on health care utilization through other means.[90]

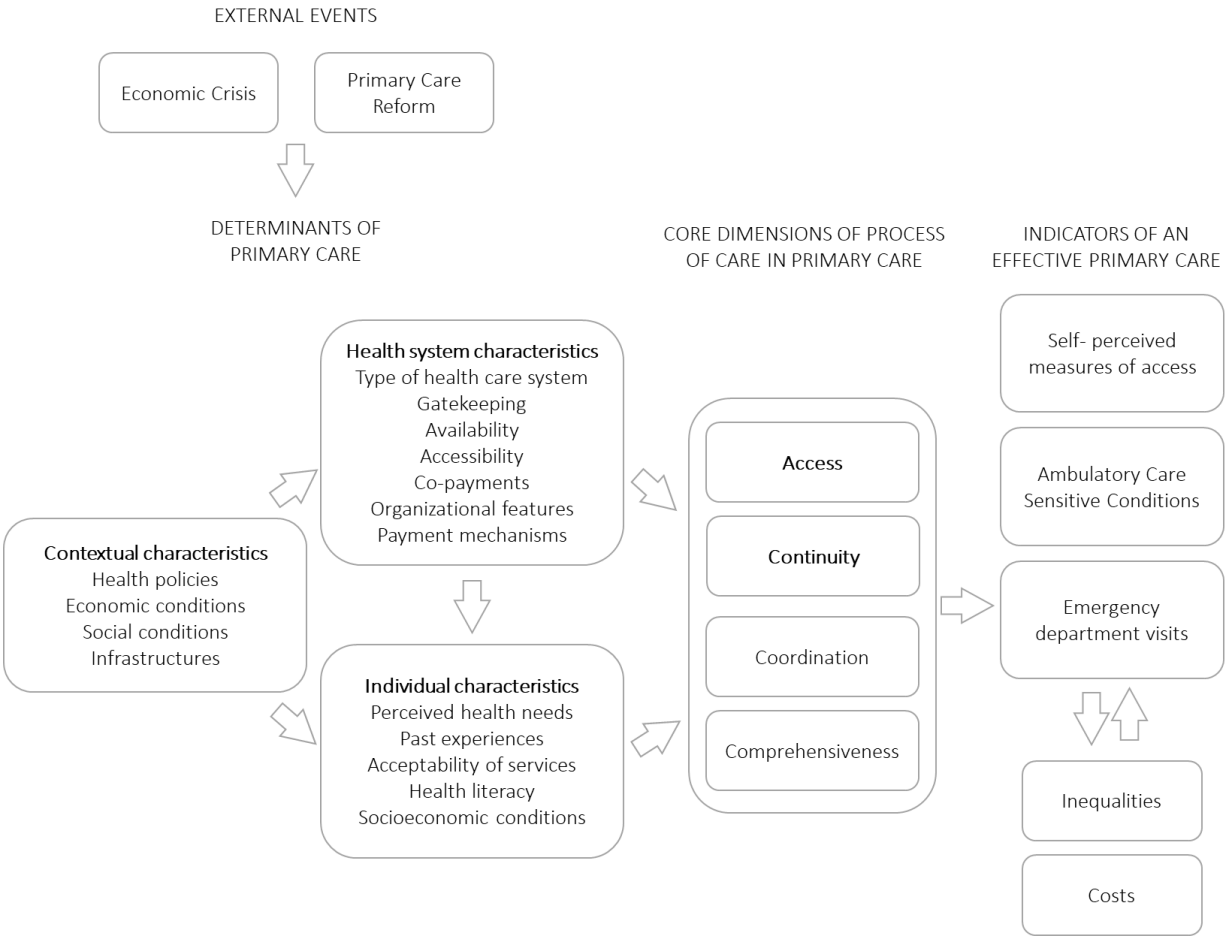
One of the self-report measures often used as a proxy for barriers to accessing care and the reasons thereof, is the self-reported unmet need for health care. This measure has become popular in recent years and is part of two large international surveys: the Survey on Health, Ageing and Retirement in Europe (SHARE) and the EU Survey of Income and Living Conditions (EU-SILC), providing an opportunity for comparative research on access to health care.[48] In the Eurobarometer survey on health and long-term care (2007) the individual´s barriers to access to primary care, specialized care, hospital care, and long-term

care are measured by the “difficulty” in accessing such services.[55] Despite some level of subjectivity and respondent bias, self-reported measures are often used, especially in comparative studies that aim to explore inequalities in health and access to care.

2. Research hypotheses and objectives

The main objectives of this doctoral dissertation are to evaluate changes and inequalities in access to primary care in Europe and in Portugal; and to evaluate the impact of the Portuguese primary care reform on secondary care use. Based on these objectives and from what is already known from the literature review, four research hypotheses arise. The theoretical framework for these hypotheses is outlined in Figure 1 and detailed below, along with the four secondary objectives of the dissertation.

Figure 1. Theoretical framework for research hypotheses



First hypothesis and objective:

It is hypothesized that access to primary care will be seen to have worsened during the Great Recession, especially for the more disadvantaged groups of the population. An economic crisis (external event) may have an impact on access to primary care due to the governmental response to the economic crisis through health policies that may or may not be primary care oriented (contextual characteristics). Consequently, there might be a disinvestment in health care that may influence the availability, affordability, and other organizational features of primary care (health system characteristics). Additionally, the aggravation of people´s socioeconomic status may deteriorate health conditions leading to a greater need for care provision (individual characteristics). Specifically, the objective is to evaluate the (self-reported) access to primary care in Europe before and during the Great Recession.

Second hypothesis and objective:

It is hypothesized that there will be a socioeconomic patterning in ACSC that may reflect the socioeconomic inequalities in access to primary care and continuity of care in Portugal. Individuals with low education and/or low income (individual characteristics), and especially those who live in socioeconomically deprived areas (contextual characteristics) or in areas with a lower or inadequate supply of primary care services (health system characteristics) may experience a lower access to primary care and lower continuity of care, which can lead to a lower treatment compliance. Specifically, the role of individual and contextual socioeconomic characteristics in access and continuity of care will be explored, and the objective is to measure the evolution of inequalities in ACSC in Portugal and their cost.

Third hypothesis and objective:

It is hypothesized that people assigned to the new primary care provision model that was created during the Portuguese primary care reform (i.e. FHUs), will have a lower use of emergency departments. A primary care reform (external event), which always has to be accompanied by supportive governmental policies (contextual characteristics), can have an important impact on the characteristics of the health system. For example, the reform can focus on the organizational features of the primary care system (e.g. shifting from single-handed practices to multidisciplinary teams and longer opening hours), leading to better access and continuity of care and ultimately influence the secondary care use. Changes in

the health system may also influence patients' perceptions of the quality of care provided, leading to a higher utilization of health services (individual characteristics). Specifically, the objective is to measure the effect of different organizational models of primary care provision in Portugal on emergency department visits and potential savings.

Fourth hypothesis and objective:

It is hypothesized that the Portuguese primary care reform (as measured by the creation of FHUs) will have an impact on the reduction of the rate of ACSC. As mentioned above, a primary care reform is an external event that can have an important impact on the characteristics of the health system, such as availability (higher supply of general practitioners), on the organizational features of the primary care system (e.g. shifting from single-handed practices to multidisciplinary teams and longer opening hours), and on the general practitioners' remuneration process (introduction of pay-for-performance), and therefore have an impact on the process of care. Additionally, changes in the health system may also influence a patient´s perceptions of the quality of care provided, leading to a higher utilization of health services and treatment compliance (individual characteristics). This can ultimately influence patient health outcomes and the secondary care use. Specifically, the objective is to measure the impact of the Portuguese primary care reform on the rate of ACSC and explore the effectiveness of the introduction of the pay-for-performance scheme on disease specific ACSC related to health conditions targeted by the financial incentives.

In order to respond to these objectives, the dissertation developed four papers, presented in the results chapter (Chapter 4). The objectives, hypotheses, and the research papers in which these are addressed are summarized in Table 1.

Table 1. Dissertation objectives, hypotheses, and research papers

Main objective	Secondary objective	Hypothesis	Original research paper
Evaluate changes and inequalities in access to primary care in Europe and Portugal.	Evaluate the access to primary care in Europe before and during the Great Recession.	Access to primary care will worsen after the Great Recession, especially for the more disadvantaged groups of population.	"Changes in access to primary care in Europe and its patterning, 2007-12: a repeated cross-sectional study"
	Measure the evolution of inequalities in ACSC in Portugal and their cost.	There will be a socioeconomic patterning in ACSC that may reflect the socioeconomic inequalities in access to primary care and continuity of care in Portugal.	"Evolution and financial cost of socioeconomic inequalities in ambulatory care sensitive conditions: an ecological study for Portugal, 2000–2014"
Evaluate the impact of the Portuguese primary care reform on secondary care use.	Measure the effect of different organizational models of primary care provision on emergency department visits and potential savings.	People assigned to the new primary care provision model, created during the Portuguese primary care reform (i.e. FHU), will have a lower use of emergency department visits.	"Primary care strengthening and emergency department visits in Portugal, 2013-2015: comparing two models using a propensity score approach"
	Measure the impact of the Portuguese primary care reform on the rate of ACSC and explore the effectiveness of the introduction of the pay-for-performance scheme on disease specific ACSC related to health conditions targeted by the financial incentives.	The Portuguese primary care reform (measured by the creation of FHUs) will have an impact on the reduction of ACSC.	"Effect of a national Primary care reform on avoidable hospital admissions (2000-2015): a difference-in-difference analysis"

3. Methods

3.1. Data sources

In the first paper individual and household data from the 2007 and 2012 cross-sectional waves of the European Statistics on Income and Living Conditions of 28 European countries were used. In the second paper the Hospital Morbidity Database (*Base de dados de Morbilidade Hospitalar*) on all in-patient stays at all public non-specialized Portuguese NHS hospitals for the years 2000 to 2014 was used. In the third paper the database on the Portuguese Emergency Department visits on all patients that visited an emergency department in all public Portuguese NHS hospitals for the years 2013 to 2015 was used, as well as data on the geographical area of influence of both primary care provision models between 2010-2015. In the fourth paper the Hospital Morbidity Database was used, merged with data on the geographical location (municipality) on all FHUs that opened in Portugal in the 2006-2015 period. Additionally, demographic and socioeconomic data at the municipality level from the Portuguese National Institute for Statistics were used in all papers except in the first. Note that in all papers "Portugal" refers to mainland Portugal, only. The autonomous regions of Madeira and Azores are not included in the analysis.

3.1.1. European Statistics on Income and Living Conditions

The European Statistics on Income and Living Conditions is a harmonized representative population survey on income distribution and social inclusion in Europe that contains individual and household data on income, living conditions, and some aspects of health and health seeking behaviors. that the survey covers all 28 European Union member states as well as Iceland, Norway, and Switzerland. It combines cross-sectional and longitudinal waves that incorporate annual health, demographic, and socioeconomic micro-data for a sample of persons aged 16 years or older from 2005 on. In addition to the core variables collected annually, a set of additional variables are collected approximately every five years, in *ad hoc modules*.[91]

The European Statistics on Income and Living Conditions data are available from Eurostat upon request and formal application. All necessary steps according to legislation were followed and a Data User Agreement was completed before the access to micro-level data.

3.1.2. Portuguese Hospital Morbidity Database

The Hospital Morbidity Database (*Base de dados de Morbilidade Hospitalar*) includes data on all ambulatory and in-patient stays at all public Portuguese NHS hospitals since 1989. This database includes, for each in-patient stay, several demographic (e.g. date of birth, sex, residence geographic code) and clinical characteristics (e.g. diagnosis, comorbidities, procedures) coded according to the International Classification of Diseases, Ninth Revision, Clinical Modification. It also gathers information on the date of admission and date of discharge, along with other administrative information. First, each ambulatory and in-patient episode is coded by trained Medical Doctors in each of the NHS hospitals, and then a Diagnosis Related Group is assigned according to the *grouper* defined in the legislation for each year. The data are sent to the Portuguese Central Administration of the Health System (*Administração Central do Sistema de Saúde*), which is responsible merging all of the data as well as for providing them to other entities. The Portuguese Hospital Morbidity Database is mainly used to measure hospital production, complexity, and costs, and has also been used extensively for research purposes by academics.[92]

The data are made available to the *Escola Nacional de Saúde Pública da Universidade NOVA de Lisboa* through a formal protocol. For research purposes the data are then made available upon request and formal application. All of the necessary steps according to regulation were followed before gaining access to the data.

3.1.3. Portuguese Emergency Department visits database

The Portuguese Emergency Department visits database contains data on all patients who visited an emergency department in all public Portuguese NHS hospitals. The database includes sociodemographic (e.g. age, sex, exemption from co-payments) and clinical information (e.g. pre-existing health comorbidities coded according to the International Classification of Primary Care) of the patient, as well as administrative information at the primary care level, namely the attribution of a Family Physician, the organizational provision model of primary care to which the patient is assigned (FHU-A, FHU-B or PHCU), and the number of medical and nursing consultations made at the primary care level). Finally, it contains information about the number and type of emergency department visits that the particular patient had in a specific year, and the number of emergency department visits that led to an in-patient stay. Note that the data are not organized by emergency department visit, but by patient.

The data were made available by the Portuguese Central Administration of the Health System according to the research protocol celebrated with the *Escola Nacional de Saúde Pública da Universidade NOVA de Lisboa* for the study "*Avaliação da reforma dos Cuidados de Saúde Primários centrada nos ganhos de economia, eficiência e eficácia resultantes da transformação de UCSP em USF*".

3.1.4. Statistical data form the National Institute of Statistics

Municipality and year-level data on demographic, socioeconomic, and health conditions of the Portuguese population between 2000 and 2015 are available without charge from the Portuguese National Institute for Statistics. Specifically, data on total inhabitants per municipality, proportion of people 65 years old or older, proportion of males, disease-specific mortality rates, population density, primary care physician supply, purchasing power, illiteracy rate, and proportion of people with tertiary education were used.[93]

Data on the proportion of people 18 years old or older per municipality and year (2000-2015) were made available to us by the National Institute for Statistics for a fee.

3.1.5. Data on primary care functional units

The data on all FHUs that opened in Portugal in the 2006-2015 period were made available by the Portuguese Central Administration of the Health System according to the research protocol celebrated with the *Escola Nacional de Saúde Pública da Universidade NOVA de Lisboa* for the study "*Avaliação da reforma dos Cuidados de Saúde Primários centrada nos ganhos de economia, eficiência e eficácia resultantes da transformação de UCSP em USF*". The data contained information on the name of the Family Health Unit, the model type (A or B), the date of opening, and date of model transition, if applicable. Additionally, for the 2010-2015 period, data on the geographical location (parish) of the people under the area of influence of each primary care provision model (FHU and PHCU) were made available.

All of the data used in these papers were previously anonymized by the responsible entities so that none of the individuals could be identified. This dissertation was undertaken in compliance with all regulations regarding data protection. There are no conflicts of interests to declare.

3.2. Summary of variables and statistical analysis

Due to the diversity of variables and statistical methods used thought the four papers, in this sub-section only a summarized table of the variables and statistical analysis used in each paper is presented (Table 2). To avoid repetition, the full and detailed description can be found in each paper, in the results chapter.

Table 2. Methods used in each of the four research papers

Original research paper	Data sources	Variables	Statistical analysis
"Changes in access to primary care in Europe and its patterning, 2007-12: a repeated cross-sectional study"	2007 and 2012 waves of the European Statistics on Income and Living Conditions questionnaire.	Dependent variable: self-reported access to primary care. Explanatory variables: year, individual socioeconomic and country-level health system characteristics. Covariates: sex, age, civil status, country of birth, chronic condition, and self-reported health.	Multilevel mixed-effects logistic regression with two level predictors.
"Evolution and financial cost of socioeconomic inequalities in ambulatory care sensitive conditions: an ecological study for Portugal, 2000–2014"	Portuguese Hospital Morbidity Database from 2000 to 2014. Statistical data from the National Institute of Statistics from 2000 to 2014.	Dependent variable: rate of ACSC per 1,000 inhabitants and ACSC related costs per inhabitant. Explanatory variables: area-based socioeconomic indicators (illiteracy and purchasing power, in quintiles). Covariates: area-based proportion of elderly, sex, disease specific mortality rate, population density, primary care supply, year and municipality fixed-effects, time trend.	Longitudinal data analysis: panel data regression.
"Primary care strengthening and emergency department visits in Portugal, 2013-2015: comparing two models using a propensity score approach"	Portuguese Emergency Department visits database from 2013 to 2015. Data on primary care functional units 2010-2015. Statistical data from the National Institute of Statistics 2010-2015.	Dependent variable 1: type of primary care provision model. Explanatory variables 1: area-based demographic and socioeconomic characteristics. Dependent variable 2: number of emergency department visits. Explanatory variables 2: type of primary cate provision model. Covariates 2: demographic and socioeconomic characteristic of the patients, severity of the emergency department visit, pre-existing clinical conditions and having a general practitioner.	Inverse probability weighting estimation. Negative binomial regression.
"Effect of a national Primary care reform on avoidable hospital admissions (2000-2015): a difference-in-difference analysis"	Portuguese Hospital Morbidity Database from 2000 to 2015. Data on primary care functional units 2006-2015. Statistical data from the National Institute of Statistics from 2000 to 2015.	Dependent variable: rate of ACSC per 1,000 inhabitants and disease-specific rates of ACSC. Explanatory variable: "adopting" *vs.* "non-adopting" municipality of the primary care reform. Covariates: area-based demographic and socioeconomic characteristics; year and municipality fixed-effects, regional-specific time trends/municipality-specific time trends, Leads and Lags.	Generalized difference-in-difference analysis.

4. Results

The results of this dissertation consist in the elaboration of four papers (original research articles). This chapter presents an integral copy of the published/submitted papers following the guidelines of each journal. The tables and figures numeration, as well as the reference style were adapted for the purpose of this dissertation. All references are presented at the end of the dissertation. The summary results of each paper are presented below.

The first paper shows that access to primary care improved between 2007 and 2012, and this improvement was greater for people living in countries with a higher investment in health and primary care. This demonstrates that supportive primary care policies are essential especially during economic recession periods. However, the poor access among low-socioeconomic status persons was stable over this period, showing that more attention should be given to the reduction of inequalities in access to primary care.

The second paper shows that in Portugal, despite universal coverage and relatively low co-payments in primary care, there are significant socioeconomic inequalities in ACSC. Furthermore, there was an increasing socioeconomic patterning in the rate of ACSC between 2000 and 2014 that possibly reflects the increase in socioeconomic inequalities in access and continuity of care in primary care, possibly contributing to the widening of the health gap. These socioeconomic inequalities impose a substantial financial burden on the Portuguese NHS and reflect the current lack of a nationally-oriented research strategy on health inequalities, and point to the need to implement effective public policies to reduce social inequalities.

The third paper shows that the primary care reform in Portugal was initiated in municipalities with better health outcomes, a larger and younger population, and greater purchasing power. Furthermore, it indicates that patients assigned to the new organizational model of primary care provision in Portugal have a lower emergency department utilization, with potential savings. At the same time, this current way of primary care organization possibly causes asymmetries in access and in the quality of services provided, raising concerns of the reforms´ induced inequalities in the provision of primary care. The first step to reduce these inequalities should be to achieve the full coverage of the Portuguese population by general practitioners in order to reduce, to some extent, the inequalities in access to primary care.

The fourth paper shows that the Portuguese primary care reform (as measured by the creation of FHUs) was adopted by municipalities that already presented lower rates of

ACSC, reinforcing the belief that the voluntary establishment of the FHUs led to the opening of these units in municipalities with better health outcomes. The rate of ACSC has continuously increased over the last 16 years, which might be in part explained by the population ageing and increase in chronic diseases. Results also showed that the creation of FHUs did not significantly reduce the rate of ACSC or the rate of disease-specific ACSC related to health conditions targeted in the pay-for-performance scheme. This study emphasizes that pay-for-performance in primary care has not been consistently effective in improving patient health outcomes. A redefinition of the pay-for-performance scheme in primary care in Portugal should be considered.

4.1. Changes and inequalities in access to primary care in Europe.

4.1.1. Changes in access to primary care in Europe and its patterning, 2007-2012: a repeated cross-sectional study.

Klára Dimitrovová[1], Julian Perelman[1,2]

[1]Escola Nacional de Saúde Pública, Universidade NOVA de Lisboa. Lisbon, Portugal
[2]Centro de Investigação em Saúde Pública, Escola Nacional de Saúde Pública, Universidade NOVA de Lisboa. Lisbon, Portugal

Abstract

Background: The strengthening of primary care has been encouraged as a strategy to achieve more efficient and equitable health systems. However, the Great Recession may have reduced access to primary care. This paper analyses the change in access to primary care and its patterning in 28 European countries between 2007 and 2012.
Methods: We used data from the 2007 and 2012 waves of the European Statistics on Income and Living Conditions questionnaire (n=687,170). The dependent variable was the self-reported access to primary care ("easy" versus "difficult"). We modeled the access to primary care as a function of the year and individual socioeconomic and country-level health system variables, using a mixed effects logistic regression, adjusting for sex, age, civil status, country of birth, chronic condition, and self-reported health. Additionally, we interacted the year with socioeconomic and country-level variables.
Results: The probability of reporting difficult access to primary care services was 4% lower in 2012, in comparison with 2007 (OR=0.96, p<0.01). People with the lowest educational level (OR=1.63, p<0.01), high difficulty to make ends meet (OR=1.94, p<0.01), and with material deprivation (OR=1.25, p<0.01) experienced a significantly higher likelihood of difficult access. The better access in 2012 was significantly higher in people living in countries with higher health expenditures, a greater number of generalist medical practitioners, and with stronger gatekeeping.
Conclusion: Access to primary care improved between 2007 and 2012, and this improvement was greater for people living in countries with a higher investment in health and primary care. However, the poor access amongst low-socioeconomic status people was stable over the period.

Key words: primary care; access; great recession; socioeconomic inequalities; Europe

Introduction

An adequate access to primary care is essential to ensure disease prevention, early diagnosis, and adequate referral to secondary care.[6] The strengthening of primary care has therefore been encouraged internationally as a strategy to achieve more efficient health systems through infrastructure, qualified primary care professionals, and supportive primary care policies.[94]

Access to primary care can be influenced by health systems and individual features. On the system side, the main determinants are (i) availability, such as the sufficient supply of general practitioners and equipment; (ii) geographical accessibility; (iii) organizational features, such as the existence of an appointment system, after-hours care arrangements and home visits; and (iv) affordability. On the individual side, we may mention (i) health needs and patient behaviour, i.e., the propensity to visit (or not) a general practitioner according to self-perceived needs; and (ii) socioeconomic status, i.e., low-educated people may lack awareness and knowledge of the health system and may delay search for needed healthcare due to financial constraints on transportation costs or co-payments.[10]

During an economic recession, access to primary care may be affected through disinvestment in healthcare, which may influence the availability, affordability, and other organizational features of primary care, and due to variations in people´s socioeconomic status and health needs. During the Great Recession, which has affected most of the European countries since 2008, some countries were better prepared than others as a result of some preexisting fiscal measures (e.g. Czech Republic, Italy, Lithuania, and Slovakia), but other countries, such as Greece, Spain, and Portugal, had to adopt strict fiscal austerity, with large budget cuts and public sector reforms that may have restricted access to healthcare.[95] Studies performed in Portugal,[96] Greece,[97] and in the Baltic states[98] reported a significant increase in “unmet medical need” during this period. The odds of reporting having an unmet medical need more than doubled in Portugal, the odds of facing unmet medical need were higher for unemployed and uninsured patients in Greece, and the main reason for this increase in Latvia and Estonia was the inability to afford care and long waiting lists, respectively.

Nevertheless, to the best of our knowledge, no study has assessed the self-reported access to primary care during this period, even though it is the main avenue to healthcare for most European citizens. Using a large database from 28 European countries, we analysed the change in self-reported access to primary care before and during the Great Recession; we examined if some countries’ health system characteristics influenced

access to primary care during this period; and we examined if low-socioeconomic status people have been more affected than others during this period.

Methods

Data sources:

We used individual and household data from the 2007 and 2012 cross-sectional waves of the European Statistics on Income and Living Conditions questionnaire of 28 European countries. European Statistics on Income and Living Conditions is a harmonized representative population survey on income distribution and social inclusion in Europe. The non-response rates varied from 8% (Cyprus) to 42% (Denmark) and from 5% (Romania) to 58% (Denmark) in 2007 and 2012, respectively.[99] Our final sample comprised 687,170 individuals aged 25 to 81 years old. We excluded individuals younger than 25 years old (n=119,408) because we used education as an important covariate of the socioeconomic status, and people younger than 25 are less likely to have concluded their education. Country level data were obtained from the OECD,[100–102] World Health Organization,[103] Eurostat,[104] and World Bank sources.[105]

Dependent variable:

We used the question on access to primary care services to evaluate the self-perceived access to primary care. Here, "primary care services" refers to "a general practitioner, a primary health centre, or to a casualty department or similar, where first-aid treatment could be received", and access is defined in terms of the financial, physical, technical, and health conditions of the household (e.g. distance, opening hours, infrastructure and equipment for people with physical disability), but not in terms of quality.[106] Note that the access is evaluated for the household as a whole, which means, for example, that "if one member of the household has a disability, but if another member can access easily to the service for him, without representing any burden for the household, then the service would be considered as easily accessible by the entire household".(p.3)[106] Therefore, all individuals within the household are classified as having the same difficulty to access to primary care.

First, the question "From the place where you live, does the household use the services of primary health care facilities?" is rated as "used" and "not used", and only if answered "used", is there the subsequent question, "How do you rate this access?", which is assessed on a Likert scale: 1 "with great difficulty"; 2 "with some difficulty"; 3 "easily" or 4 "very easily".[106] We created a binary variable for "difficult access to primary care" by combining the first and second options, and the third and fourth, since only

4.11% of our sample experienced “great difficulty” of accessing primary care. We excluded observations with missing data on the use of primary care (n=1,999; 0.3% of the sample), and individuals who did not rate the difficulty in access because they did not use primary care services (n=11,502; 1.6% of the sample).

Explanatory variables:

A recession is said to occur when real Gross Domestic Product (GDP) falls for two consecutive calendar quarters.[107] We measured the change across time using a year binary variable, with the 2007 wave representing access to primary care before the Great Recession, when none of the 28 countries had a negative percentage change in GDP based on the previous year; and the 2012 wave representing the access to primary care during/post Great Recession, when 13 of the 28 countries still had a negative percentage change in GDP in the previous year, and others were in a recent post-recession period.[108]

We used individual socioeconomic characteristics to measure differences in access between the low-socioeconomic vs. high-socioeconomic status people. We used the education level, the ability to make ends meet, and material deprivation. Note that the last two variables are collected at the household level, therefore all individuals within the household have the same values. We divided the education categories into three levels, and the ability to make ends meet into four categories. We created a dummy variable of material deprivation based on the Eurostat definition as the enforced inability (rather than the choice not to do so) to afford at least three of nine specific items considered by most people to be desirable or even necessary to lead an adequate life.[109]

We also used as explanatory variables specific health system characteristics that may influence the propensity to visit a general practitioner, such as: the supply of primary care services measured by the rate of generalist medical practitioners per 1,000 inhabitants[104], the total health expenditure per capita (*US Dollar, 2010 constant prices, constant PPPs, OECD base year*),[100,105] and the existence of a gatekeeping system to specialist services (2, “fully enforced gatekeeping system”; 1, “moderate gatekeeping”; and 0, “no gatekeeping”).[101–103]

Covariates:

We controlled for individual variables, namely age, sex, civil status, country of birth, self-reported health, and the existence of a chronic condition, as proxies for needs.[110] Observations with missing data on any of the explanatory variables or covariates were excluded (n=25,007; 3.5% of the sample).

Statistical analysis:

We modelled the self-reported access to primary care as a function of the year, and individual socioeconomic and country-level variables, using multilevel mixed-effects logistic regression, with two level predictors. The use of a multilevel mixed-effects model (i.e. containing both fixed effects and random effects) is justified by individuals being nested in different countries.[111] In our data, level 1 corresponds to the fixed equation of the model at the individual-level in which the odds ratios are analogous to those in a standard regression and are estimated directly. Level 2 corresponds to the random equation of the model at the country-level, which is intended for modelling the intra-country correlation, since the observations in the same country are correlated because they share common cluster-level random effects. These random effects take the form of random intercepts or random coefficients, and are summarized according to their estimated variances and covariances.[111] This was the base model (Regression I). Additionally, we performed two separate regressions with interactions. Regression II contains interaction terms between year and level 1 variables (socioeconomic variables of the individual), with the assumption that the Great Recession might have affected access to primary care differently in low-socioeconomic and high- socioeconomic status people. Regression III contains interaction terms between year and level 2 variables, with the assumption that the Great Recession might have influenced access to primary care differently in countries with different rates of generalist medical practitioners per 1,000 inhabitants, with different total health expenditures per capita, and with different gatekeeping systems.

The likelihood-ratio test comparing the model to ordinary logistic regression without the conditional set of random effects was highly significant ($p<0.00$) for all our models, precluding the use of a simple logistic regression model.[111] Furthermore, a similar methodology has been used by other researchers, using 2009 European Statistics on Income and Living Conditions data, to study unmet needs.[112] All the analyses were conducted with Stata version 13.

Results

Descriptive analysis:

Descriptive statistics are presented in Table 3. In 2007 and 2012, 22% and 21% of individuals reported having difficult access to primary care services, respectively. People with no education/primary education fell from 17% to 15% between 2007 and 2012, and the percentage of people with difficulties/great difficulties to make ends meet rose from 26% to 31%. The mean total health expenditure per capita and the rate of generalist

medical practitioners per 1,000 inhabitants was 2,650$ and 0.94, and 2,840$ and 0.95 in 2007 and 2012, respectively, and 44% of the individuals lived in a country with fully enforced gatekeeping systems.

Between 2007 and 2012, 17 countries experienced a decrease in the difficulty of accessing primary care, with the highest decrease observed in Lithuania (-10.9pp) and the lowest decrease observed in Italy (-0.1 pp). Eleven countries experienced an increase in the difficulty of accessing primary care, with the lowest increase reported in France (0.1 pp) and the highest increase reported in Romania (9.0 pp). (Figure 2)

Table 3. Individual/household´s and country level characteristics in 2007 and 2012 of primary care users.

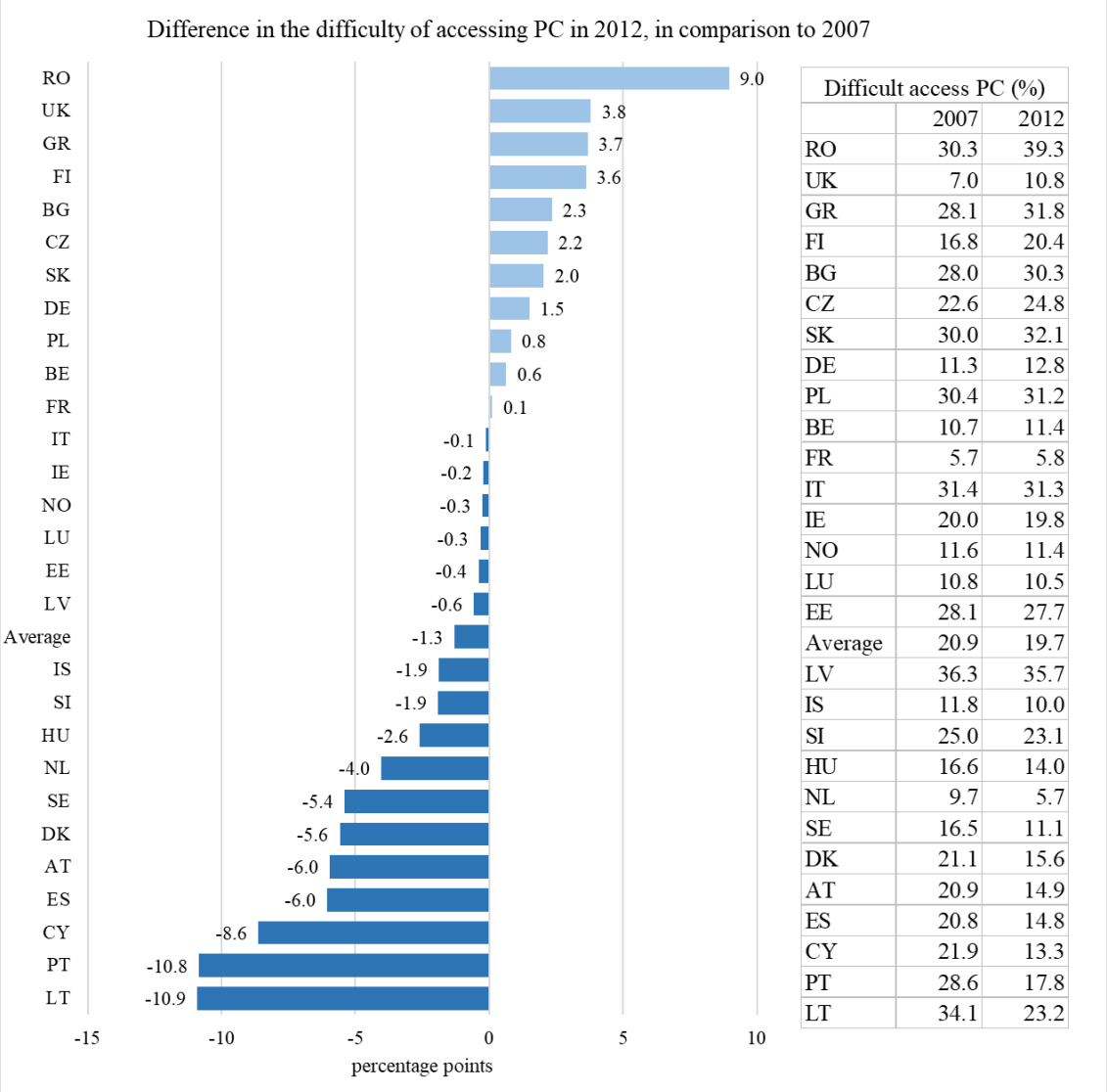
	2007 (n=339,453)		2012 (n=347,717)	
Individual characteristics	**n**	**%**	**n**	**%**
Difficult access to primary care	73,903	22	72,280	21
Age (Mean (SD))	52	(16)	53	(16)
Male	157,713	46	160,326	46
Married	218,141	64	214,014	62
Country of birth (same as residence)	313,449	92	317,591	92
Country of birth (any other European Union country)	8,762	3	11,637	3
Country of birth (any other country)	17,242	5	18,489	5
Education[1]				
Tertiary education	85,858	25	97,212	28
Secondary education	193,440	57	198,276	57
No education/ primary education	60,155	17	52,229	15
Deprivation	68,314	20	76,583	22
Ability to make ends meet				
Easily or very easily	64,269	19	59,076	17
Fairly easily	84,974	25	78,082	22
With some difficulty	103,438	30	103,461	30
With difficulty or great difficulty	86,772	26	107,098	31
Self-reported health				
Very good	59,711	18	61,129	18
Good	141,483	42	151,323	44
Fair	91,954	27	90,559	26
Bad or very bad	46,305	14	44,706	13
Chronic condition	113,635	33	122,999	35
Country level characteristics				
Gatekeeping[2]				
No gatekeeping	83,189	25	81,885	24
Moderate gatekeeping	106,903	31	111,037	32
Fully enforced gatekeeping	149,361	44	154,795	44
Total health expenditure per capita (Mean (SD))	2,650	(1,210)	2,840	(1,310)
Rate of GMP per 1,000 inhabitants (Mean (SD))	0.94	(0.54)	0.95	(0.50)

Notes: Source: EU-SILC 2007 and 2012; Sample: individuals aged 25 and over

[1] The levels of education were constructed based on the aggregation of ISCED (International Standard Classification of Education) levels: 0-1, 2-3 and 4-5 for “no education / primary education”, “secondary education” and “tertiary education”, respectively.

[2] **No gatekeeping:** AT (Austria) CY (Cyprus) CZ (Czech Republic) DE (Germany) GR (Greece) IS (Iceland) LU (Luxembourg) SE (Sweden); **Moderate gatekeeping:** BE (Belgium) BG (Bulgaria) EE (Estonia) FI (Finland) FR (France) IE (Ireland) LV (Latvia) PL (Poland) SK (Slovak Republic); **Fully enforced gatekeeping:** DK (Denmark) ES (Spain) HU (Hungary) IT (Italy) LT (Lithuania) NL (Netherlands) NO (Norway) PT (Portugal) RO (Romania) SI (Slovenia) UK (United Kingdom).

Figure 2. Difference in reporting difficult access to primary care between 2007 and 2012, by country.



Difficult access PC (%)	2007	2012
RO	30.3	39.3
UK	7.0	10.8
GR	28.1	31.8
FI	16.8	20.4
BG	28.0	30.3
CZ	22.6	24.8
SK	30.0	32.1
DE	11.3	12.8
PL	30.4	31.2
BE	10.7	11.4
FR	5.7	5.8
IT	31.4	31.3
IE	20.0	19.8
NO	11.6	11.4
LU	10.8	10.5
EE	28.1	27.7
Average	20.9	19.7
LV	36.3	35.7
IS	11.8	10.0
SI	25.0	23.1
HU	16.6	14.0
NL	9.7	5.7
SE	16.5	11.1
DK	21.1	15.6
AT	20.9	14.9
ES	20.8	14.8
CY	21.9	13.3
PT	28.6	17.8
LT	34.1	23.2

Notes: Source: European Statistics on Income and Living Conditions 2007 and 2012 waves; authors' computations. Switzerland, Croatia and Malta are not included due to missing data in 2007.
PC – Primary Care

Multivariate analysis:

The probability of reporting difficult access to primary care services was 4% lower in 2012 in comparison with 2007 (OR=0.96, p<0.01) (Regression I, Table 4). People with the lowest educational level (OR=1.63, p<0.01), with the highest difficulty to make ends meet (OR=1.94, p<0.01), and with material deprivation (OR=1.25, p<0.01) experienced a significantly higher likelihood of difficult access to primary care services. Also, people with the poorest self-reported health and people with a chronic condition experienced a

significantly higher difficulty in accessing primary care (OR=1.71, p<0.01 and OR=1.03, p<0.01, respectively).

People living in countries with higher total health expenditures per capita and with a higher rate of generalist medical practitioners per 1,000 inhabitants experienced a lower difficulty of accessing primary care. Specifically, a 1,000 US$ higher health expenditure per capita was associated with a 4% improvement in access to primary care (OR=0.96, p<0.1), and a one-point higher rate of generalist medical practitioners per 1,000 inhabitants was associated with a 34% significantly lower probability of difficult access to PC (OR=0.66, p<0.01).

The effect of individual socioeconomic characteristics during the Great Recession

The statistical significance of the interactions was tested using the contrasts of marginal linear predictions test.[113] The results were statistically significant only for education (p<0.01). Between 2007 and 2012 there was a slight but significant improvement in access to primary care, for those with secondary education in comparison with those with tertiary education (OR=0.99, p<0.01), but overall there were no significant changes in the socioeconomic patterning of access to primary care (Regression II, Table 5).

The effect of the health systems characteristics during the Great Recession

The results for the interacting terms were statistically significant (p<0.01) for all health systems characteristics, which indicates that between 2007 and 2012 access to primary care was significantly improved for people living in countries with higher total health expenditures per capita; with higher rate of generalist medical practitioners per 1,000 inhabitants, and with fully enforced gatekeeping systems (OR=0.94, p<0.01) (Regression III, Table 5).

Table 4. Multilevel mixed-effects logistic regression for the probability of reporting difficult access to primary care, between 2007 and 2012, in 28 European Countries.

	Regression I		
Difficult access to primary care	OR (odds ratio)	(95% CI)	
Year 2007	1		
Year 2012	0.96***	(0.95;	0.98)
Individual characteristics			
Age	1.00***	(1.00;	1.00)
Female	1		
Male	1.02***	(1.01;	1.03)
Not married	1		
Married	1.00	(0.98;	1.01)
Country of birth (same as residence)	1		
Country of birth (any other European Union country)	0.95**	(0.91;	0.99)
Country of birth (any other country)	0.73***	(0.71;	0.75)
Education (tertiary education)	1		
Secondary education	1.21***	(1.19;	1.23)
No education / primary education	1.63***	(1.59;	1.66)
No Deprivation	1		
Deprivation	1.25***	(1.23;	1.27)
Make ends meet (Easily or very easily)	1		
Fairly easily	1.32***	(1.29;	1.35)
With some difficulty	1.72***	(1.68;	1.76)
With difficulty or great difficulty	1.94***	(1.89;	1.99)
Self-reported health (Very good)	1		
Good	1.13***	(1.11.	1.15)
Fair	1.29***	(1.26;	1.33)
Bad or very bad	1.71***	(1.66;	1.76)
No chronic condition	1		
Chronic condition	1.03***	(1.02;	1.05)
Country level characteristics			
No gatekeeping	1		
Moderate gatekeeping	1.28	(0.83;	1.98)
Fully enforced gatekeeping	1.06	(0.70;	1.61)
Health expenditure	0.96*	(0.93;	1.00)
Rate of generalist medical practitioners	0.66***	(0.61;	0.72)
Intercept (general)	0.14	(0.10;	0.20)
Intercept (country)	0.20	(0.12;	0.35)

*** p<0.01; ** p<0.05; * p<0.1

Notes: The intra-class correlation (ICC) for the empty model was 0.10 (95% CI 0.06; 0.16) and 0.06 (95% CI 0.04; 0.10) after the addition of all individual variables.

Table 5. Multilevel mixed-effects logistic regression for the probability of reporting difficult access to primary care, including individual and country level interactions with year.

	Regression II			Regression III		
Difficult access to primary care	OR	(95% CI)		OR	(95% CI)	
Year 2007	1			1		
Year 2012	0.94***	(0.90;	0.98)	1.22***	(1.16;	1.28)
Individual characteristics						
Education (tertiary education)	1			1		
Secondary education	1.18***	(1.16;	1.21)	1.21***	(1.19;	1.23)
No education. / primary education	1.63***	(1.58;	1.68)	1.63***	(1.59;	1.66)
No Deprivation	1			1		
Deprivation	1.24***	(1.21;	1.27)	1.26***	(1.24;	1.28)
Make ends meet (Easily or very easily)	1			1		
Fairly easily	1.31***	(1.27;	1.35)	1.32***	(1.29;	1.35)
With some difficulty	1.69***	(1.64;	1.75)	1.72***	(1.68;	1.76)
With difficulty or great difficulty	1.97***	(1.91;	2.04)	1.94***	(1.86;	1.99)
Individual level interactions						
Education # year 2012						
Education (tertiary education)	1					
Secondary education	1.05***	(1.02;	1.09)			
No education / primary education	1.00	(0.96;	1.04)			
Deprivation # year 2012	N/S					
Make ends meet # year 2012	N/S					
Country level characteristics						
No gatekeeping	1			1		
Moderate gatekeeping	1.26	(0.82;	1.94)	1.36	(0.87;	2.12)
Fully enforced gatekeeping	1.05	(0.70;	1.58)	1.19	(0.78;	1.81)
Health expenditure	0.95**	(0.91;	0.99)	1.03	(0.98;	1.07)
Rate of GMP	0.66***	(0.61;	0.72)	0.73***	(0.66;	0.79)
Country level interactions						
Gatekeeping # 2012						
No gatekeeping				1		
Moderate gatekeeping				0.98	(0.94;	1.03)
Fully enforced gatekeeping				0.86***	(0.83;	0.89)
Health expenditures # 2012						
Health expenditure				0.96***	(0.95;	0.98)
Rate of GMP # 2012						
Rate of GMP				0.93***	(0.90;	0.96)
Intercept (general)	0.15	(0.10;	0.21)	0.10	(0.07;	0.14)
Intercept (country)	0.20	(0.12;	0.34)	0.21	(0.13;	0.36)

*** p<0.01; ** p<0.05; * p<0.1 Notes: Both regressions included as confounder the age, sex, civil status, country of birth, self-reported health and chronic condition. The odds ratios for these variables were not included in the table to ease the reading. OR – odds ratio; #: interaction; N/S: not significant; GMP – generalist medical practitioners

Discussion

Key findings and interpretation:

First, our study shows that the probability of reporting difficult access to primary care in 28 European countries fell by 4% in 2012, in comparison to 2007. Some studies showed that unmet medical needs increased significantly across Europe during the Great Recession.[96–98,114–116] However, these studies did not investigate where these needs were unmet. Our finding clearly suggests that these worrisome results may not have been caused by access to primary care. In fact, during the Great Recession, in many countries there was an impulse toward outpatient care through the substitution of secondary care with primary care, an increased centralization of hospitals with improved coordination in primary care, and an overall investment in primary care.[22,23]

For example, in Portugal despite the increase in user charges (co-payments) at all levels of care, it was ensured that this rise was proportionally lower for primary care, and that the fees remained relatively low. Also, other incentives were set for patients to go first to primary care, such as the exemption of user charges in emergency care from episodes that resulted from referral by a general practitioner.[117] In Latvia, co-payments for general practitioners were kept relatively unchanged, despite the increase for outpatient care. Additionally, the share of spending on general practice care increased from 9% in 2008 to 14% in 2010, and the payments to general practitioners also rose by 45% during this period.[23] Also in Lithuania primary care suffered less drastic budget cuts as compared with other levels of care, and had funding priority. In addition, providers were forced to increase efficiency by introducing incentives to treat more patients in primary care (amongst other measures), in order to maintain access to healthcare.[23] In the Netherlands general practitioners were given a more central role in the provision of care in the community, and their role as gatekeepers was strengthened. Also, specialized nurses to provide care for patients with chronic diseases were introduced at the primary care level. In order to achieve this, the expenditure on general practice care was allowed to grow by 2.5% per year between 2014 and 2017, while other healthcare expenditures were forced to decrease.[23] In Belgium one of the programme aimed at strengthening primary care was to grant financial incentives to general practitioners to establish their practices in deprived areas.[23] There are thus many examples suggesting that in some

countries the budget cuts in the healthcare sector did not affect the most basic and inexpensive care, and were even accompanied by improved access to primary care.

Second, our study also shows that people with low socioeconomic status, i.e. with lower education, lower ability to make ends meet, and those with material deprivation, reported poorer access to primary care, suggesting significant socioeconomic inequalities in favour of the high-socioeconomic status people, after controlling for need differences. Earlier studies report no evidence of income-related inequality in the utilization of primary care services, measured by the probability of visiting a general practitioner, and by the conditional number of visits, in European Union[118] and OECD[119] countries. Some authors even report a pro-poor distribution in some countries.[119,120] We assume that accessing primary care represents a considerable burden for people with low-socioeconomic status, and that they may live in socioeconomic disadvantaged areas where access to primary care may be influenced by the availability (or not) of transportation systems, by the distance to primary care facilities, and by a shortage of primary care physicians.[39] We used a subjective measure of the economic hardship (make ends meet) instead of income, since this perceived economic well-being is an important indicator for understanding the financial capacity of the individual at any age.[121] This measure is used in many studies, and has shown clear associations with health outcomes.[122] Nevertheless, we also performed the analysis using quintiles of income, and the socioeconomic patterning was maintained, with the people in the lowest quintiles of income experiencing a significantly greater likelihood of difficult access to primary care services, in comparison with the highest quintile of income (OR=1.63, $p<0.01$).

Third, our study shows that in 2012, in comparison to 2007, there were no substantial changes in the socioeconomic patterning of access to primary care, which suggests that the socioeconomic inequalities in access to primary care remained the same, which is consistent with the persistent socioeconomic inequalities in health in Europe.[123] Nonetheless, it also indicates that during the period of the economic crisis the most vulnerable populations were not impaired in relation to the better-off, and that some policy measures were in place to provide some social and financial protection to the poorer people. For example, in Portugal, exemptions to user charges increased considerably, with the purpose of protecting the lower-income people and other vulnerable population groups.[117] Also, in the Netherlands the decrease of care allowance was adjusted in a way that people with lower incomes experienced less reduction than people with higher incomes and additional protection was offered for general practice care, maternity care, and care for children.[22]

Finally, our results show that during the Great Recession people living in countries with higher total health expenditures per capita, with higher rate of generalist medical

practitioners per 1,000 inhabitants, and with fully enforced gatekeeping systems experienced a greater improvement in access to primary care. Recent evidence showed that European countries with higher overall health expenditures had stronger primary care systems, possibly due to the decentralization of services delivery and due to the necessary costs of maintaining this strong structure, but had also slower growth in healthcare spending.[11] This result suggests that countries with higher investment in health and primary care resources were better equipped to face the detrimental effect of the crisis in access to primary care.

Limitations:

This study has some limitations that should be addressed. First, it would be desirable to measure the yearly evolution of the difficulty of access to primary care before and during the entire period of the Great Recession. However, data regarding the access to primary care are available only in the *ad-hoc* modules of the European Statistics on Income and Living Conditions questionnaire, which are collected every five years. Therefore, we were able to analyse the changes in access to primary care only between 2007 and 2012, which however correspond well to the pre and post-recession period.

Second, we did not measure access in terms of effectiveness, quality, and continuity of care, since these are not taken into consideration in the questionnaire. Therefore, some people may have good physical access to primary care but they may have poor treatment compliance, lower quality of care, or lower continuity of care.

Third, access is a broad concept and the perception of the difficulty in access to primary care may vary both within and across countries. Even though there is a comprehensive validation procedure applied for the European Statistics on Income and Living Conditions questionnaire data,[124] to the best of our knowledge, no specific validation of the "access to primary care" question was performed. Note however that the Eurobarometer survey on health and long-term care (2007)[55] used a similar question.

Fourth, the European Statistics on Income and Living Conditions questionnaire does not address primary care non-utilization, and it is therefore not possible to know if non-users do not use primary care services by choice (e.g. people with high socioeconomic status who use specialized private care), or because they are not able to do so (e.g. very low socioeconomic status people who face major access barriers). Additionally, the non-utilization of health services may not be a function of individual choice, since some choices are not informed due to a lack of education or of culturally acceptable services.[125] Hence, even if non-users represented only 1.6% of the sample, our analysis might be biased by considering only the sub-sample of users. In order to evaluate this potential

bias, we performed an additional analysis, using a two-stage regression. First we estimated the predicted probability of the use of primary care services for each individual, using a probit regression. Then we replicated the original logistic regressions weighting observations by the inverse predicted probability of being a primary care user, from the probit regression. We found no differences in the odd ratios between the two models, i.e. with and without sample weights, which suggests that the results in terms of access to primary care are not biased by the non-users (see full results in Appendix I).

Finally, although European Statistics on Income and Living Conditions questionnaire is a standard and comparable survey that contains a nationally representative samples of individuals aged 16 years and older in 32 European countries, it has some limitations.[91] Sampling methods vary across countries, and the non-responses are handled through proxy interviewing and imputation of missing data, in order to complete samples and avoid selection bias. The full information about quality reports of each country is publicly available elsewhere.[99]

Key Points

- Access to primary care improved between 2007 and 2012, and this improvement was greater for people living in countries with a higher investment in health and in primary care.
- Low-socioeconomic status people report poorer access to primary care and this was stable between 2007 and 2012.
- Supportive primary care policies are essential especially during economic recession periods; nevertheless, more attention should be given to the reduction of inequalities in access to primary care.

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4.1.2. Evolution and financial cost of socioeconomic inequalities in ambulatory care sensitive conditions: an ecological study for Portugal, 2000-2014

Klára Dimitrovová[1], Cláudia Costa[2], Paula Santana[3], Julian Perelman[1,4]

[1]Escola Nacional de Saúde Pública, Universidade NOVA de Lisboa. Lisbon, Portugal
[2]Centre of Studies on Geography and Spatial Planning, University of Coimbra. Coimbra, Portugal
[3]Centre of Studies on Geography and Spatial Planning, Department of Geography, University of Coimbra. Coimbra, Portugal
[4]Centro de Investigação em Saúde Pública, Escola Nacional de Saúde Pública, Universidade NOVA de Lisboa. Lisbon, Portugal

Abstract

Background: Hospitalizations for Ambulatory Care Sensitive Conditions (ACSC) are specific conditions for which hospitalization is thought to be avoidable through patient education, health promotion initiatives, early diagnosis and by appropriate chronic disease management, and have been shown to be greatly influenced by socioeconomic characteristics. We examined the socioeconomic inequalities in hospitalization rates for ACSC in Portugal, their evolution over time (2000-2014), and their associated financial burden.

Methods: We modeled municipality-level ACSC hospitalization rates per 1,000 inhabitants and ACSC hospitalization-related costs per inhabitant, for the 2000-2014 period (n=4,170), as a function of socioeconomic indicators (illiteracy and purchasing power, in quintiles), controlling for the proportion of elderly, sex, disease specific mortality rate, population density, primary care supply, and time trend. The evolution of inequalities was measured interacting socioeconomic indicators with a time trend. Costs attributable to ACSC related hospitalization inequalities were measured by the predicted values for each quintile of the socioeconomic indicators.

Results: Hospitalization rate for ACSC was significantly higher in the 4th quintile of illiteracy compared with the 1st quintile (beta=1.97; p<0.01), and significantly lower in the 5th quintile of purchasing power, compared with the 1st quintile (beta=-1.19; p<0.05). ACSC hospitalization-related costs were also significantly higher in the 4th quintile of illiteracy compared with the 1st quintile (beta=4.04€; p<0.05), and significantly lower in the 5th quintile of purchasing power, compared with the 1st quintile (beta=-4,69€; p<0.01). The socioeconomic gradient significantly increased over the 2000-2014 period, and the annual cost of inequalities were estimated at more than 15 million euros for the Portuguese NHS.

Conclusion: There was an increasing socioeconomic patterning in ACSC related hospitalizations, possibly reflecting increasing socioeconomic inequalities in early and preventive high-quality care, imposing a substantial financial burden to the Portuguese NHS.

Key words: ambulatory care sensitive conditions; primary care; socioeconomic inequalities; costs

Background

Hospitalizations for Ambulatory Care Sensitive Conditions (ACSC) have been largely studied as an indirect measure of access to effective primary care.[77] ACSC related hospitalizations are defined as specific conditions (e.g., asthma, angina, heart failure, diabetes and hypertension) for which hospitalization is thought to be avoidable through patient education, health promotion initiatives, early diagnosis, early treatment, and by appropriate chronic disease management, i.e., by "timely and effective primary care".[59,71] The reason for considering these conditions as avoidable is that they can be managed in order to avoid their clinical progression. For example, early diagnosis, adequate treatment and change in lifestyle should avoid the hospitalization of a person with diabetes.

Despite evidence that increased physician supply and greater diffusion of primary care are associated with lower rates of ACSC hospitalizations,[42,60] many authors suggest that ACSC related hospitalizations are more closely related to socioeconomic characteristics than with the quality of primary care.[39,63] Many studies have indeed found a strong socioeconomic gradient in the rates of hospitalizations for ACSC, showing that people from low-income areas, people living in rural and/or more deprived areas, and people from areas with higher proportions of uneducated people have a much higher risk of being hospitalized for these conditions.[49,71–73] These socioeconomic disparities have been described not only in countries without universal health coverage, like the United States, but were also found in countries like Canada,[75] Italy,[74] the United Kingdom,[54] and Sweden,[126] where there are little financial barriers in access to primary care.

We can classify explanations for socioeconomic inequalities in ACSC related hospitalizations into two categories: those related to individual characteristics and those related to contextual characteristics. With regard to individual characteristics, patients with lower literacy may be less prone to adopt self-management behaviors;[54] they may have a lower probability of enrolling in health promotion activities;[52] they may have a poor understanding of physicians' recommendations, leading to poorer treatment

compliance;[49] they may lack awareness and knowledge of the health care system;[52] and they may face language and cultural barriers.[53] Patients with low income may also delay the search for needed medical care or medications due to financial constraints on transportation costs and healthcare co-payments.[51]

Regarding contextual factors, authors suggest that patients from lower-income areas may face a shortage of primary care physicians and fewer referrals to specialist consultations,[38,54] leading to a lower continuity of care and to a delay in care.[37] We can hypothesize also that the quality of services is lower in more deprived and rural areas, due for example to insufficient financing. In addition, more individuals in low-income areas are hospitalized for social reasons, due to non-response or lack of coordination with social services.[38] Finally, access to primary care may be influenced in socioeconomic disadvantaged areas through the availability of transportation systems and by the distance to primary care facilities.[39] Most studies on this topic are ecological, and authors use socioeconomic characteristics of the area of residence of the individual to explore these associations, since it is believed that the aggregate socioeconomic characteristics reflect the nature of the social environment where people live.[127]

In this paper we measured socioeconomic inequalities in ACSC related hospitalizations, their evolution over time, and financial consequences for the Portuguese NHS. The use of a long period of time permits a more consistent measurement of inequalities, and testing whether these socioeconomic inequalities in ACCS related hospitalizations have risen, potentially contributing to the growing relative inequalities in health in the last decade.[123] Finally, by measuring the costs attributable to inequalities, we estimate the potential savings that would be achieved and potentially reallocated to other needs.

The case of Portugal is of interest because it combines a universal coverage in primary care, characterized by relatively low co-payment rates and a large network of primary care practices, with a relatively weak social welfare system. Portugal is also one of the European Union countries with the highest inequalities in income distribution and risk of poverty,[128] and recent evidence showed considerable socioeconomic health inequalities[31] and strong associations between material deprivation and mortality.[129]

Methods

Data sources:

We used data from the Portuguese Central Administration of the Health System on all in-patient stays at all public non-specialized Portuguese NHS hospitals for the years 2000 to 2014 (n=11,129,000). This database includes, for each patient, several clinical

(e.g. diagnosis, comorbidities) and demographic characteristics (e.g. age, sex, residence geographic code). Using information from the patients´ residence geographic code, the data on ACSC related hospitalizations were aggregated by municipality and year, and merged with municipality and year-level data on demographic, socioeconomic and primary care physician supply data from the National Institute for Statistics. Our total number of observations was n=4,170, which corresponds to the total number of municipalities (n=278) followed over the 15-years period. Note that the municipality is the second lowest administrative level in Continental Portugal.

Dependent variable:

We used the set of codes for ACSC related hospitalizations as defined by the United States Agency for Healthcare Research and Quality, which are called Prevention Quality Indicators. We opted for the Agency for Healthcare Research and Quality definition because it is widely used in the United States, and has also been adapted and adopted by different European countries including Spain[130] and Italy,[58] allowing for the comparison of results. We also used this approach because it is in accordance to the Portuguese in-patient disease classification system (International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM)). We used the overall set of 12 Prevention Quality Indicators validated for adult population, defined as "PQI 90 Overall composite" (Table 6). The detailed list of inclusion and exclusion of ICD-9-CM codes for the construction of Prevention Quality Indicators is described elsewhere.[57]

Based on the patients´ residence geographic code, we calculated the total number of ACSC related hospitalizations ("PQI 90 Overall composite") per municipality and year. Then we calculated the rate of ACSC related hospitalizations per 1,000 adult inhabitants (≥18 years old) by dividing the total number of ACSC related hospitalizations by the total adult population in the municipality and year. Additionally, we calculated the ACSC-related costs per inhabitant, for each municipality and year. This cost was estimated by computing the total costs of all ACSC related hospitalizations previously identified per municipality and year, using the official Portuguese NHS prices attributed to each in-patient stay, based on its Diagnosis Related Groups, and then divided by the total adult population in each municipality and year. We used the decree-laws, published regularly by the Ministry of Health, with the official NHS prices which were in force in the period under analysis.[131] Note that these costs correspond only to the in-patient episode and do not include any other pre-existing health expenses that the patient may have had in other healthcare settings.

Table 6. Ambulatory Care Sensitive Conditions (Prevention Quality Indicators) defined by Agency for Healthcare Research and Quality

Individual Prevention Quality Indicators (PQIs)
PQI 01 Diabetes Short-term Complications Admissions Rate
PQI 03 Diabetes Long-term Complications Admission Rate
PQI 05 COPD or Asthma in Older Adults Admission Rate
PQI 07 Hypertension Admission Rate
PQI 08 Heart Failure Admission Rate
PQI 10 Dehydration Admission Rate
PQI 11 Bacterial Pneumonia Admission Rate
PQI 12 Urinary Tract Infection Admission Rate
PQI 13 Angina without Procedure Admission Rate
PQI 14 Uncontrolled Diabetes Admission Rate
PQI 15 Asthma in Younger Adults Admission Rate
PQI 16 Rate of Lower-Extremity Amputation Diabetes
Composite Prevention Quality Indicators (PQIs)
PQI 90 Overall composite (includes 01, 03, 05, 07, 08, 10, 11,12, 13, 14, 15, and 16)

Source: [57]

Explanatory variables:

We first used as an explanatory variable the municipality year-level purchasing power, which indicates the relative purchasing power in buying goods and services in a given municipality for the average wage in that same municipality. The national purchasing power was used as reference, with a value of 100. That is, if in a given municipality the purchasing power is 60, the inhabitants of this municipality with an average salary can afford 40% fewer typical goods and services than the average residents in Portugal. This indicator is calculated bi-annually; for the in-between years we used average values. Second, we used the municipality-year-level illiteracy rate, defined as the proportion of people aged 10 or more years old who cannot read or write. As mentioned above, illiteracy greatly influences disease prevention and self-management behaviors, leading to a higher risk of hospitalization.[52] In Portugal, illiteracy rates are available only for census years (2001 and 2011), and so for the in-between years we conducted linear interpolation.

Covariates:

We controlled for the municipality year-level proportion of elderly, sex, disease specific mortality rate, population density and primary care supply. The proportion of elderly was measured as the proportion of people with 65 or more years of age in each

municipality, since ACSC related hospitalizations are mostly prevalent at older ages, especially after the age of 65 years,[54] and sex was measured as the proportion of males in each municipality. Disease-specific mortality rate for diabetes, chronic obstructive pulmonary disease (COPD) and ischemic heart diseases (as defined in the European Shortlist for Causes of Death[132]) were used as covariates to adjust for disease prevalence and severity, since areas with higher mortality are more likely to have greater health needs, associated with higher ACSC related hospitalizations.[60] We used these chronic conditions since they are the ones that contribute notably for ACSC related hospitalizations.[60] Population density was used to account for rurality, and primary care supply was measured by the rate of primary care physicians working in primary care practices per 1,000 inhabitants in each municipality and year. This indicator is one of the best proxies for primary care supply, and has been used by other authors.[42] Finally, we included a time trend, allowing control for the other growth factors in the rate of ACSC related hospitalizations.

Statistical analysis:

We used quintiles of the distribution for our socioeconomic explanatory variables, with the first quintile being the lowest. This approach was used by other authors in similar studies[63] and it seeks to obtain categorical values in order to explore nonlinearities. We added all covariates as continuous. Note that for illiteracy the first quintile is the least deprived (less percentage of people with illiteracy), while for purchasing power the first quintile is the most deprived.

We first calculated the absolute difference and the population-attributable risk of the rate of ACSC related hospitalizations per 1,000 inhabitants for each socioeconomic indicator. The absolute difference aims to measure the difference in ACSC related hospitalizations between opposite quintiles (most deprived versus least deprived). The population-attributable risk corresponds to the difference between the mean rate of ACSC related hospitalizations and the rate of ACSC related hospitalizations of the least deprived quintile, given as a percentage of the mean rate of the ACSC related hospitalizations. In other words, the population-attributable risk describes the reduction in the rate of ACSC related hospitalizations that would be observed if the entire population had the characteristics of the least deprived socioeconomic quintile.[133]

We then modeled the ACSC hospitalization rates (Model I) and the ACSC-related costs per inhabitant (Model II) as a function of year-specific quintiles for the socioeconomic indicators, controlling for the proportion of elderly, sex, disease specific mortality rate, population density, primary care supply, and for the time trend. In order to

estimate the evolution of socioeconomic inequalities in the 2000-2014 period, we interacted the illiteracy rate and purchasing power with the time trend (Model III and IV, respectively), controlling for all the covariates. All four models used longitudinal data analysis (panel data) and were regressed using the ordinary least squares with municipality fixed effects.[134] We used municipality fixed effects since we are interested in analyzing the impact of only the variables that vary over time, and we aim to explore the causes of changes within the entity, i.e., the relationship between explanatory and outcome variables within the municipality. Fixed effects control for all-time invariant differences between the municipalities, so the estimated coefficients of the fixed-effects models cannot be biased due to omitted time-invariant characteristics such as culture, historical determinants, or institutional settings.[135] Additionally, a Hausman test ($p<0.01$) and a Prob F test ($p<0.01$) confirmed the utilization of fixed instead of random effects.

Finally, we calculated the costs attributable to ACSC related hospitalization inequalities, from the Portuguese NHS perspective (i.e. the additional direct costs incurred in ACSC related hospitalizations arising as a result of socioeconomic inequalities), for the year 2014. With this analysis, we aimed at estimating the total hypothetical savings that would be obtained if the pattern of cost was similar for all quintiles of socioeconomic variables. To do so, we first calculated the predicted values for each quintile of the socioeconomic indicators of the Model II, in order to estimate the predicted cost per inhabitant by quintile. These predicted values are a post estimation, which means that they are calculated from the predictions of a previously fitted model, in which some of or all the covariates are fixed, for example at their means.[136] We then multiplied the predicted ACSC-related cost per inhabitant by the total adult population in each quintile of illiteracy and purchasing power. We also estimated a hypothetical cost by multiplying the predicted ACSC-related cost per inhabitant of the least deprived quintiles by the total adult population. Lastly, the costs attributable to inequalities were estimated by the difference of the two costs. All the analyses were conducted with Stata version 13 (StataCorp LP, College Station, TX, USA).

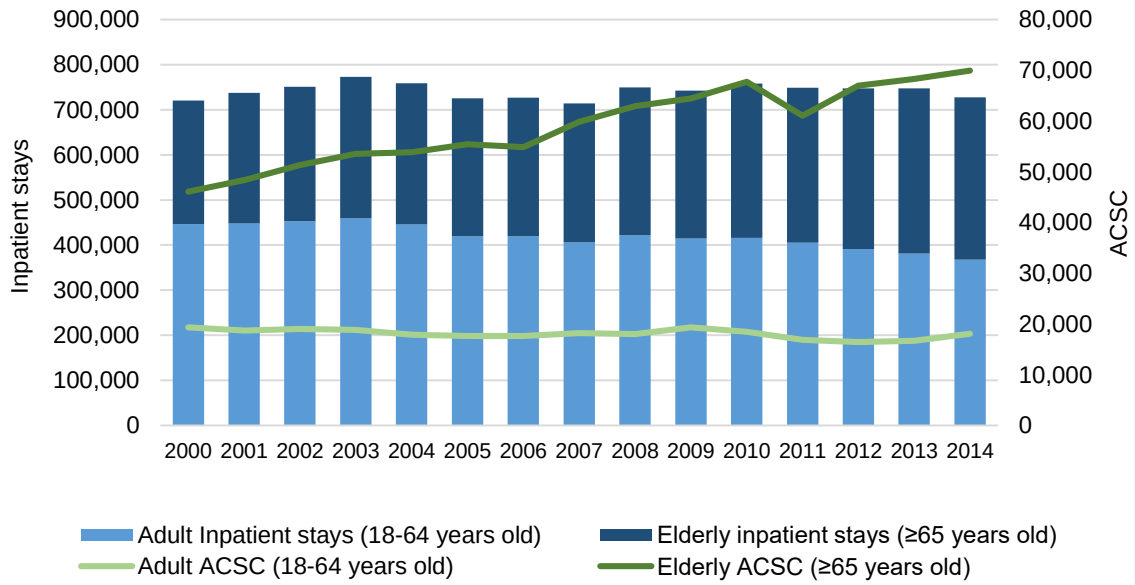
Results

Descriptive analysis:

In Portugal, between 2000 and 2014, there were on average 741,933 public hospital discharges of adults (age ≥ 18 years) annually, among which 77,077 (10.4%) were potentially avoidable. While the total number of in-patient stays maintained relatively stable over the 2000-2014 period (from 720,414 in 2000 to 727,495 in 2014), the total number of ACSC related hospitalizations increased from 65,401 to 88,006 (a 34.6%

increase). Considering only the elderly (age ≥ 65 years), there was a 51.7% increase in ACSC elderly related hospitalizations, which represented 70% and 79% of the total ACSC related hospitalizations in 2000 and 2014, respectively (Figure 3).

Figure 3. Adult and elderly inpatient stays and hospitalizations for ambulatory care sensitive conditions in Portugal, 2000–2014



The crude national rate of ACSC related hospitalizations per 1,000 inhabitants increased from 8.29 in 2000 to 10.81 in 2014, while the hospital utilization rate decreased from 91.28 per 1,000 inhabitants to 89.32 per 1,000 inhabitants over the same time period. Table 7 shows the overall descriptive characteristics of our unit of analysis (municipalities) in 2000 and 2014.

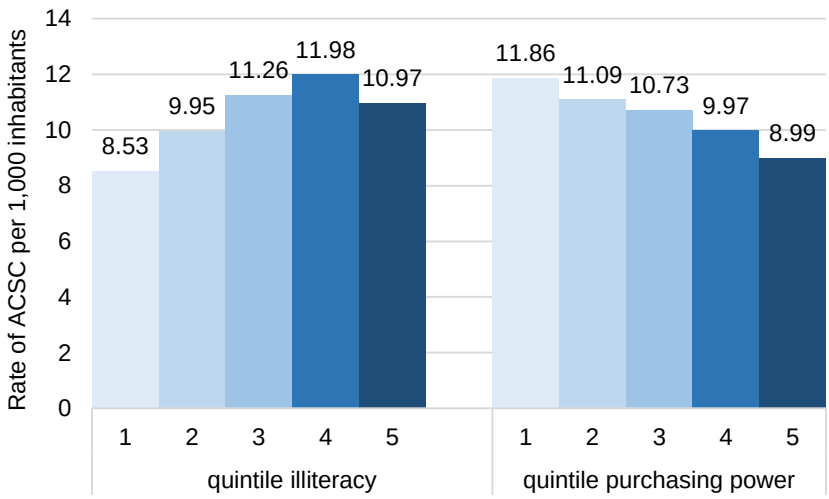
Table 7. Sample characteristics: ambulatory care sensitive conditions and their determinants in Portugal, 2000-2014

Indicator (per municipality)	2000 (n=278)				2014 (n=278)			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Rate of ACSC hospitalizations per 1,000 inhabitants	8.59	3.31	0.18	22.00	12.55	4.65	4.67	28.15
Total population	35,415	56,851	1,918	563,475	35,503	56,926	1,739	509,312
Adult population (≥ 18 years old)	28,391	46,286	1,597	480,710	29,297	46,549	1,457	422,951
Elderly population (≥ 65 years old)	5,839	9,742	498	132,637	7,314	12,069	391	141,742
Proportion of elderly (≥ 65 years) (%)	21.08	6.59	8.42	40.84	24.37	6.09	11.81	44.97
Proportion of males (%)	47.85	1.18	43.10	53.01	47.01	1.07	43.12	52.48
Proportion of illiterate people (%)	14.04	5.72	3.90	33.25	6.76	3.32	1.75	17.57
Purchasing power	66.65	28.91	33.72	305.19	82.40	17.26	57.89	201.75
Primary care physicians per 1,000 inhabitants	0.76	0.20	0.17	1.79	0.71	0.21	0.00	1.44
Diabetes mortality rate per 1,000 inhabitants	0.46	0.27	0.00	1.46	0.69	0.39	0.00	2.77
COPD mortality rate per 1,000 inhabitants	0.46	0.27	0.00	1.46	0.69	0.39	0.00	2.77
Heart disease mortality rate per 1,000 inhabitants	0.95	0.52	0.00	3.49	1.22	0.82	0.00	6.22
Population density (N.º/ km²)	307	870	7	7,518	304	831	4	7,398

Univariate analysis:

The absolute difference is of 2.44 ACSC related hospitalizations per 1,000 inhabitants for illiteracy and 2.87 ACSC related hospitalizations per 1,000 inhabitants for purchasing power (Figure 4). If we could decrease the illiteracy levels to the lowest quintile, we would reduce the rate of ACSC related hospitalizations by 19.00% (population-attributable risk). Similarly, if we could increase the purchasing power to the highest quintile, we would reduce the rate of ACSC related hospitalizations by 14.63%.

Figure 4. Rate of hospitalizations for ambulatory care sensitive conditions by socioeconomic quintiles in Portugal, 2000–2014



	Difference in prevalence	Population attributable risk
Illiteracy (1: least deprived; 5: most deprived)	2.44	19.00%
Purchasing power (1: most deprived; 5: least deprived)	2.87	14.63%

Multivariate analysis:

The rate of ACSC related hospitalizations was positively and significantly associated with illiteracy, being 1.32 ($p<0.01$), 1.10 ($p<0.05$), 1.97 ($p<0.01$), and 1.59 ($p=0.05$) higher for quintiles two, three, four, and five, respectively in comparison to the first quintile (Model I) (Table 3). Similarly, the ACSC-related costs per inhabitant were 2.37€ ($p<0.05$) and 4.04€ ($p<0.05$) higher for the second and fourth quintile of illiteracy in comparison to the first quintile (Model II) (Table 8). The rate of ACSC related hospitalizations was significantly and negatively associated with purchasing power, being 0.86 ($p<0.01$), 1.21 ($p<0.01$), and 1.19 ($p<0.01$) lower for the third, fourth, and fifth quintiles, respectively, in comparison to the first quintile (Model I) (Table 3). The ACSC-

related costs per inhabitant were also significantly lower, being 3.07€ ($p<0.01$), 4.34€ ($p<0.01$), and 4.69€ ($p<0.01$) lower for the third, fourth and fifth quintiles of purchasing power respectively, in comparison with the first quintile (Model II) (Table 8).

Furthermore, the rate of ACSC related hospitalizations was positively and significantly associated with the COPD mortality rate and with the heart disease mortality rate. For each unit increase in the COPD mortality rate and for each unit increase in the heart disease mortality rate, there is an increase of 1.01 ($p<0.01$) and 0.33 ($p<0.01$) hospitalizations for ACSC per 1,000 inhabitants. The ACSC-related costs per inhabitant were also significantly higher for these indicators, as well as for the diabetes mortality rate. Regarding primary care supply, each unit increase in the rate of primary care physicians per 1,000 inhabitants was associated with a decrease of 1.29 ($p<0.01$) hospitalizations for ACSC per 1,000 inhabitants and with a decrease of 3.08€ ($p<0.01$) ACSC-related-costs per inhabitant. In our study, the proportion of elderly, proportion of males and population density were not statistically significantly associated with the rate of ACSC related hospitalizations and with the ACSC-related costs. Finally, the time trend shows that overall the rate of ACSC related hospitalizations and the ACSC-related costs per inhabitant increased in the 2000-2014 period. Each year there was an increase of 0.23 ($p<0.01$) in the rate of ACSC related hospitalizations, and an increase of 0.53€ ($p<0.01$) in ACSC-related costs per inhabitant.

The interaction between the time trend and illiteracy was positive and significant for the rate of ACSC related hospitalizations while the interaction between the time trend purchasing power was negative and significant (Model III) (Table 9), indicating in both cases an increase in socioeconomic inequalities. Specifically, each year there was a statistical significant increase in the rate of ACSC related hospitalizations of 0.42 ($p<0.01$), 0.41 ($p<0.01$), and 0.37 ($p<0.05$) for the third, fourth, and fifth quintiles of illiteracy, respectively, in comparison to the first quintile. Similarly, there was a statistical significant decrease in the rate of ACSC related hospitalizations of 0.16 ($p<0.01$), 0.10 ($p<0.01$), 0.14 ($p<0.01$) and 0.05 ($p<0.01$) for the second, third, fourth, and fifth quintiles of purchasing power, respectively, in comparison to the first quintile. The interactions had similar results for ACSC-related costs per inhabitant (Model IV) (Table 9).

Table 8. Association between socioeconomic factors with the rate of ACSC and ACSC related-costs in Portugal, 2000-2014

		MODEL I		MODEL II	
		Rate of ACSC		ACSC related costs	
		β	(95% CI)	β	(95% CI)
Trend		0,23***	(0,19; 0,27)	0,53***	(0,43; 0,63)
Socioeconomic indicators					
Illiteracy	1 (least deprived)				
	2	1,32***	(0,59; 2,08)	2,37**	(0,28; 4,47)
	3	1,10**	(0,04; 2,16)	2,47*	(-0,46; 5,40)
	4	1.97***	(0,59; 3,34)	4,04**	(0.24; 7.83)
	5 (most deprived)	1,59*	(-0.01; 3,18)	2.47	(-1.94; 6.88)
Purchasing power	1 (most deprived)				
	2	0.00	(-0,46; 0,46)	-0.56	(-1,83; 0,72)
	3	-0.86***	(-1,46; -0,27)	-3,07***	(-4.71; -1,43)
	4	-1,21***	(-1,92; -0,50)	-4,34***	(-6,30; -2,39)
	5 (least deprived)	-1,19***	(-2,08; -0,30)	-4,69***	(-7,15; -2,22)
Confounders					
	Proportion of elderly (≥ 65 years)	0.04	(-0.06; 0.15)	0.23	(-0.07; 0.52)
	Proportion of males	-0.01	(-0.33; 0.31)	0.80*	(-0.09; 1.68)
	Diabetes mortality rate per 1,000 inhabitants	0.26*	(-0.03; 0.54)	1.07***	(0.29; 1.86)
	COPD mortality rate per 1,000 inhabitants	1.01***	(0.83; 1.20)	2.61***	(2.10; 3.11)
	Heart disease mortality rate per 1,000 inhabitants	0.33***	(0.12; 0.53)	1.23***	(0.66; 1.80)
	Population density (N.º/ km²)	-0.00	(-0.00; 0.00)	-0.00	(-0.01; 0.00)
	Primary care physicians per 1,000 inhabitants	-1.29***	(-1.97; -0.60)	-3.08***	(-4.97; -1.19)

*** p<0.01; ** p<0.05; * p<0.1; R^2 overall of MODEL I = 0.14; R^2 overall of MODEL II = 0.12

Table 9. Interaction between time trend and socioeconomic indicators with ACSC and ACSC related-costs in Portugal, 2000-2014

		MODEL III		MODEL IV	
		Rate of ACSC		ACSC related costs	
		β	(95% CI)	β	(95% CI)
Trend		0,28***	(0,19; 0,38)	0.68***	(0,42; 0.94)
Socioeconomic indicators					
Illiteracy#trend	1 (least deprived)				
	2	0,00	(-0,06; 0,07)	-0,02	(-0,19; 0,15)
	3	0,14***	(0,07; 0,20)	0,32***	(0,13; 0,51)
	4	0,13***	(0,05; 0,21)	0,27**	(0,05; 0,48)
	5 (most deprived)	0,09**	(0,01; 0,17)	0,21*	(-0.01; 0,43)
Purchasing power#trend	1 (most deprived)				
	2	-0,12***	(-0,19; -0,05)	-0,26***	(-0,44; -0,07)
	3	-0,18***	(-0,25; -0,12)	-0,47***	(-0,66; -0,29)
	4	-0,14***	(-0,22; -0,07)	-0,42***	(-0,62; -0,22)
	5 (least deprived)	-0,23***	(-0,31; -0,15)	-0,49***	(-0,71; -0,27)

*** p<0.01; ** p<0.05; * p<0.1

Note: All values were adjusted for illiteracy, purchasing power, proportion of elderly, proportion of males, diabetes mortality rate per 1,000 inhabitants, COPD mortality rate per 1,000 inhabitants, heart disease mortality rate per 1,000 inhabitants, population density and primary care supply. We exclude these variables from the table to simplify the reading.

Inequality-related costs:

In order to estimate the costs attributable to ACSC related hospitalizations inequalities, we first calculated the predicted values (predicted cost per inhabitant in each quintile of the socioeconomic indicators) for the previously fitted Model II (Table 10). All the other covariates were set at their mean values, and the estimation was not set as balanced in order to take into account the unequal sample size in each quintile.[136] We then multiplied the total adult population in each quintile by the corresponding predicted cost per inhabitant, and obtained a total cost of 207,803,901€ for illiteracy, and 205,661,714€ for purchasing power. Then we calculated a hypothetical cost by multiplying the total adult population in the year 2014 (n = 8,144,649) by the predicted cost of the least deprived quintiles of illiteracy (24.49€) and purchasing power (24.35€), assuming that all municipalities behaved as the least deprived SE quintiles (199,483,712€ for illiteracy and 198,342,076€ for purchasing power). The costs attributable to inequalities were then estimated by the difference between the “real” and the hypothetical costs, i.e. 8,320,190€ for illiteracy and 7,319,638€ for purchasing power. Therefore, if all municipalities behaved as the least deprived socioeconomic quintiles, the Portuguese NHS would save 15,639,828€ per year.

Table 10. Predicted values for ambulatory care sensitive conditions related costs, by socioeconomic indicators, in Portugal, 2000-2014

ACSC related costs	quintile	Predicted values (€)	(95% CI)	Adult population by quintile in 2014	Cost (€)
Illiteracy	1 (least deprived)	24.49***	(22.20; 26.79	4,751,169	116,368,529
	2	26.77***	(25.15; 28.38)	1,610,426	43,106,659
	3	26.53***	(25.15; 27.92)	922,640	24,482,234
	4	28.41***	(26.58; 30.24)	493,458	14,020,667
	5 (most deprived)	26.78***	(24.25; 29.31)	366,956	9,825,812
Total				8,144,649	207,803,901
Purchasing power	1 (most deprived)	29.19***	(27.87; 30.52)	374,834	10,943,140
	2	28.67***	(27.75; 29.60)	625,682	17,940,993
	3	26.13***	(25.34; 26.93)	1,033,524	27,011,139
	4	24.82***	(23.93; 25.71)	2,048,886	50,853,576
	5 (least deprived)	24.35***	(22.91; 25.79)	4,061,723	98,912,866
Total				8,144,649	205,661,714

*** p<0.01; ** p<0.05; * p<0.1

Note: All other variables of the regression (as used in Model II) were set at their means for the estimation of the predicted values for each socioeconomic indicator.

Discussion

Key findings and interpretation:

First, our data show that the national crude rate of ACSC related hospitalizations increased from 8.29 to 10.81 per 1,000 inhabitants between 2000 and 2014. These overall rates are very close to those observed in other European countries, such as Italy[58] and France.[76]

Second, our study highlights significant socioeconomic inequalities in ACSC related hospitalizations. The most disadvantaged municipalities, i.e., those with the highest levels of illiteracy and lowest levels of purchasing power, had the highest rates of ACSC related hospitalizations. In the univariate analysis, we estimated a reduction of 19.00% and 14.63% (population-attributable risk) in ACSC related hospitalization rates, if all municipalities had the illiteracy levels and purchasing power of the municipalities from the least deprived quintiles. These inequalities were largely confirmed in the multivariate analysis (i.e. adjusted for the proportion of elderly, proportion of males, diabetes, COPD and heart disease mortality rate per 1,000 inhabitants, population density and for primary care supply), and were consistent with earlier research performed in other countries with NHS. For Italy, authors found a risk ratio of 2.59 (95% CI: 2.35-2.85) for ACSC related hospitalizations, between the highest and lowest quintile of area income.[74] For Ireland, an incidence rate ratio of 4.29 (95% CI 4.20-4.39) between opposite quintiles of a deprivation index was found in the rate of ACSC related hospitalizations between 2002 and 2013.[137] Also, for Canada, authors found that patients in the lowest area income quintiles were approximately three times as likely to be hospitalized for an ACSC, relative to their counterparts in the highest area income quintile (odds ratio = 2.93, 95% CI 2.19-3.93).[75] Another study for Canada that focused on disparities in preventable heart attack hospitalizations showed that the hospitalization rate would be 16% lower if rates for all socioeconomic groups matched those in the areas with the highest income.[138]

There are individual and contextual factors that may contribute to the socioeconomic inequalities in ACSC related hospitalizations. Since our study was ecological, we relied on area-based socioeconomic variables. However, these variables can reflect both individual and contextual effects. On the one hand, area-based socioeconomic factors may proxy individual socioeconomic characteristics, that is, people living in more deprived areas are more likely to have lower literacy levels and to experience material and financial deprivation. Therefore, they are less likely to adopt self-management behaviors since they have a poorer understanding of how the disease affects their life, of how to cope with the symptoms, and of how to maintain good control throughout the course of the disease;[54] and they are more likely to experience delay in care due to

transportation costs and due to lack of knowledge of the health care system. On the other hand, area-based socioeconomic factors can reflect the socioeconomic context where people live.[127] In lower-income areas there may be lower cultural and social support for early care and prevention, and the access to primary care may be affected by the distance to primary care facilities and by the availability of transportation systems.

Third, we observe a widening of socioeconomic inequalities in the rate of ACSC related hospitalizations over the 15-year period examined. To the best of our knowledge, no other study focusing on socioeconomic inequalities and ACSC related hospitalizations has reported the evolution of inequalities over time. Nevertheless, relative socioeconomic inequalities in health in Europe have not only persisted in the last three decades but also widened, according to recent measures.[123,139] Our findings are consistent with these, suggesting that increasing inequalities in ACSC related hospitalizations, which reflect inequalities in early and preventive care, are a possible explanation for these widening disparities in health.

Finally, we estimate potential savings of more than 15 million euros per year from reducing inequalities, for the Portuguese NHS. It is worth noting that these estimates aimed only to provide an indication of the likely scale of the costs of health inequalities, since it is hypothetical to assume that everyone would have the same illiteracy levels and purchasing power as the 20% of the least deprived population. Also, not all differences observed in the distribution of the rate of ACSC related hospitalizations result from socioeconomic inequalities. There will always be differences in the distribution of illness and disease among people, regardless of their socioeconomic status.[140] Moreover, the reduction of inequalities in ACSC related hospitalizations would certainly require substantial investments, so our values for potential in-patient savings provide just a benchmark to which these investments can be compared. Despite the limitations of these assumptions, other studies use this approach.[140,141]

Limitations:

There are limitations to our study that must be addressed. First, even though most countries use a list of ACSC codes based on the initial definition from the US, different sets of ACSC codes may result in different estimation rates. Some authors suggest that the choice of ACSC related hospitalizations should be country specific due to variations in practices and health systems among countries,[59] but other authors believe that access barriers to care, especially for the most disadvantaged populations, are not unique to one context but common across countries.[74] The set of ACSC related hospitalizations as defined by the Agency for Healthcare research and Quality is not validated for the

Portuguese population, but has been validated in Italy, a southern European country with universal coverage.[58]

Second, the inequalities found in ACSC related hospitalizations may also be driven by other patient characteristics such as comorbidities and by disease prevalence. There is no regular available data on disease prevalence in Portugal, so we used as covariates the disease specific mortality rate of the three chronic conditions that contribute notably for ACSC, as was used in previous studies.[60] Regarding patient comorbidity, in contrast with other methodologies, the Agency for Healthcare Research and Quality performs an annual revision of the diagnosis/procedure codes and has defined an extensive list of exclusion criteria for each ACSC, which allows for the adjustment for some coexisting conditions. Also, there is some evidence that other determinants of health, like the percentage of smokers and proportion of people that are physically inactive could influence the rate of ACSC related hospitalizations.[142] Again, in Portugal there is no data for these variables at the municipality level, and additionally, other studies showed that the socioeconomic inequalities remained practically unchanged after controlling for lifestyle variables.[53,75,143] This may be due to the fact that lifestyles are strongly associated to socioeconomic factors.

Third, in Portugal, the inpatient database does not contain any information on the socioeconomic status of the patient. Thus, we used area-based variables of the patients' municipality of residence. Even though this could lead to ecological fallacy, because the observed correlations at the municipality level might not be true at the individual level,[144] our main objective was to describe inequalities and not to measure causalities. Note that this assumption is valid and is commonly used in similar studies,[74,76,143,145] as well as in many other studies on the association of health outcomes and area specific socioeconomic characteristics.[129,146] Furthermore, ecological studies have the advantage of using large existing datasets and can include a large number of people to test hypotheses.

Finally, we used the Diagnosis Related Groups tariffs as a proxy for the cost of each ACSC related hospitalization. Nevertheless, these tariffs are widely used for hospital prospective payment schemes and the price of each Diagnosis Related Group is widely used as a proxy for the costs, since is the best proxy for hospital costs of each in-patient episode.[147,148]

Conclusion

Despite universal coverage and relatively low co-payments in primary care, in Portugal there are significant socioeconomic inequalities in ACSC related

hospitalizations, possibly reflecting inequalities in early and preventive high-quality care. Furthermore, these inequalities increased from 2000 to 2014, possibly contributing to the widening of the health gap, and represent a substantial financial burden for the Portuguese NHS. These results reflect the current lack of a national-oriented research strategy on health inequalities and point to the need to implement effective public policies to reduce social inequalities. Further research should be developed to understand why individuals from low socioeconomic areas are more likely to be hospitalized for avoidable reasons, and how the quality of preventive and primary care services influence these specific ACSC related hospitalizations, in order to reduce current inequalities and their associated costs.

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Authors' contributions

KD contributed to study conceptualisation and design, data acquisition and analysis and interpretation and drafted the manuscript. CC contributed to study conceptualisation and manuscript revision. PS contributed to study conceptualisation and manuscript revision. JP contributed to study conceptualisation and design, data analysis and interpretation and manuscript revision. All authors read and approved the final manuscript.

4.2. Impact of the Portuguese primary care reform on secondary care use.

4.2.1. Primary care strengthening and emergency department visits in Portugal, 2013-2015: comparing two models using a propensity score approach.

Klára Dimitrovová[1], Julian Perelman[1,2]

[1]Escola Nacional de Saúde Pública, Universidade NOVA de Lisboa. Lisbon, Portugal
[2]Centro de Investigação em Saúde Pública, Escola Nacional de Saúde Pública, Universidade NOVA de Lisboa. Lisbon, Portugal

Abstract

Background: Increased access to primary care is associated with lower emergency department utilization. In Portugal, in 2006, a major primary care reform was initiated, and a new organizational model was created, the Family Health Units (FHU), partly financed by pay-for-performance. We analysed if people assigned to a FHU have a lower emergency department utilization, in comparison to those who are not.
Methods: We modelled the total number of emergency department visits (n=18,501,803) of all individuals that went to an emergency department between 2013-2015, as a function of the primary care organizational model and adjusting for patient's characteristics. We also weighted the model by the inverse probability for each patient to be assigned to a FHU. We then estimated the hypothetical number of emergency department visits and potential savings, if all patients were assigned to a FHU.
Results: Patients assigned to a FHU have a lower probability of having an emergency department visit (IRR=0.94, p<0.01). The number of potentially avoidable emergency department visits was estimated at 194,898 if we shifted all people to a FHU, which accounts for a potential saving of about 16,200,000 € a year.
Conclusion: The new organizational model of primary care provision in Portugal suggests a lower emergency department utilization by their assigned patients, however it also raises major concerns of the reforms´ induced inequalities in the access and quality of services provided.

Key words: emergency department; primary care; reform; family health units; costs; pay-for-performance

Background

The excessive use of emergency departments is a major issue in Portugal [27] as in other developed countries.[87,149] In 2015 there were a total of 625 emergency department visits per 1,000 inhabitants in Portugal, in contrast to 451 per 1,000 inhabitants in the United States [150] and 371 per 1,000 inhabitants in England´s NHS hospitals.[151] Some emergency department visits may be indicative of insufficient access to primary care and poor care management.[80,152] A recent fully controlled large-scale natural experiment, performed by Whittaker et al (2016) showed that increasing access to primary care was associated with lower emergency department utilization.[80] Other studies also suggest that extended access to primary care [81–83], better continuity of care,[84–86] or the ability to make an appointment with a particular general practitioner was associated with a lower number of emergency department visits.[87,88] Other potential determinants for emergency department visits include patient factors such as morbidity, socioeconomic factors, seasonal variation, and aging.[85,87,153] Additionally, patient behaviour is pointed to as one of the main reasons for inadequate emergency department visits.[89,153,154]

In Portugal, primary care was traditionally provided in primary care centres, in which general practitioners worked in solo practice and were paid by fixed salaries. In 2006, a major primary care reform was initiated in order to improve access and strengthen primary care. The organization of the primary care centres was redefined, and several models of primary care provision were created.[27] The most significant aspect of this reform was the creation of Family Health Units (FHU) *(Unidades de Saúde Familiar),* which consist of voluntarily constituted multidisciplinary teams of 20 health professionals on average (general practitioners, nurses, and technicians), who have functional and technical autonomy, and are partly financed through pay-for-performance, designed to reward productivity, accessibility, and quality, which can take the form of team-based incentives for FHU model A (FHU-A) and as individual incentives for FHU model B (FHU-B).[27] There are two models of FHU, A and B. All FHU start as model A and must prove a specific level of quality, and clinical and functional targets, before they are allowed to apply to transition to model B. Both models have team-based institutional incentives that correspond to monetary incentives but can only be used, for example, for the development of key infrastructure, purchase of equipment or for the completion of specific professional training.[29] Additionally, in FHU model B, there are individual financial incentives for all staff (supplementary payments) which are a variable component of the remuneration process (the rest is a fixed legislated salary). Note that these incentives can reach up to 30% of total physician remuneration, and up to 10% for nurses.[27]

It is expected that all patients covered by FHU have a designated general practitioner, and that they have better access and better continuity of care due their long-term relationship with the health professionals.

Since 2006, there was a progressive expansion of FHU across Portugal, which, because it was based on self-selection of health professionals, was unrelated to any specific geographic criteria nor population needs assessment. Consequently, the population started to be covered or not by a FHU depending on whether a new FHU was created in their area of their residence. Also, in 2006 the term "primary care centre" was eliminated and the primary care professionals who did not join the FHU model became part of the Personalized Health Care Units (PHCU) (*Unidades de Cuidados de Saúde Personalizados)* with new contracting arrangements, but which differed from FHU in staff size, organization, facilities, and payment mechanisms (without pay-for-performance).[27]

FHU are often seen as the result of a significant innovation and apparently a highly successful primary care reform, since some available data suggest that FHU are performing better than PHCU in the quality of care delivered.[28] Using data from three Portuguese NHS hospitals, in a study analysing the effect of distance to travel in the utilization of emergency department services in Portugal, the authors found that in areas with a greater availability of primary care services, especially the presence of an FHU, the utilization of emergency department services was lower.[155] At the same time, this current way of primary care organization possibly causes asymmetries in access and in the quality of services provided, raising concerns of the reforms´ induced inequalities in the provision of primary care.

In this paper we analysed if people assigned to an FHU-A or FHU-B have a lower emergency department utilization, in comparison to those assigned to a PHCU, conditional to the underlying characteristics of the population covered by each of these primary care provision models. We then estimated the potential number of emergency department visits and consequent costs that could be reduced if all patients from the PHCU were assigned to an FHU-A or to an FHU-B.

This study contributes to the literature because (i) we measure the impact of different organizational models of primary care in all emergency department visits that occurred in all public Portuguese NHS hospitals in a three year period (2013-2015); (ii) we are able to take advantage of a natural experiment in which we can compare the three models of primary care provision that resulted from the Portuguese primary care reform; (iii) we focus on a southern European country that, despite having an NHS with universal coverage and strong gatekeeping, does not have a designated general practitioner for the entire population, creating inequalities in access to primary care, which may be an explanatory factor for the persistence of strong health inequalities in Portugal.[31]

Methods

Data sources:

We used data from the Ministry of Health on all patients that visited an emergency department in all public Portuguese NHS hospitals for the years 2013 to 2015 (n=9,203,817), which contains demographic and clinical information about the patient, as well as the organizational model to which the patient is assigned at the primary care level. The costs of the emergency department visits were estimated based on the official tariffs published regularly by the Ministry of Health.[156]

Given that the assignment to FHU is not random, we compared the characteristics of FHU and PHCUs' patients, which were then used to adjust the modelling of emergency department use. This characterization was obtained from aggregated demographic and socioeconomic parish-level (the smallest administrative division in Portugal) and municipality-level data from the National Institute for Statistics (n=4,417). In 2015 there were 401 PHCU, 238 FHU-A, and 208 FHU-B, but note that each year some PHCU are transformed into FHU-A and some FHU-A progress to FHU-B.[93]

Variables:

For the first part of the analysis, devoted to the characterization of FHU users, we used as dependent variable the type of primary care provision model and as explanatory variables the year (2010-2015) and area-based demographic characteristics: proportion of elderly (age ≥65 years), proportion of males, heart disease mortality rate per 1,000 inhabitants, COPD mortality rate per 1,000 inhabitants, and diabetes mortality rate per 1,000 inhabitants (as a proxy for morbidity), and socioeconomic characteristics: percentage of people with tertiary education and purchasing power, of the population covered by each primary care provision model. As mentioned above, patient factors such as age, being male, morbidity, and socioeconomic factors can influence the number of emergency department visits, regardless of the availability of primary care.[87]

For the second part of the analysis we used as dependent variable the total number of emergency department visits that occurred in all public Portuguese NHS hospitals for the years 2013 to 2015, and we used as explanatory variables the three organizational models of primary care provision, coded as a categorical variable: 0 "PHCU", 1 "FHU-A", and 2 "FHU-B". We controlled for having a general practitioner, the year, the sociodemographic characteristic of the patients including age, sex, and the exemption of a co-payment when visiting an emergency department service (mostly related to low income), the number of emergency department visits that led to an inpatient episode (as a proxy for the severity of the emergency department visit), and preexisting conditions

namely diabetes, hypertension, neoplasm, asthma, COPD, depression, anxiety, smoker, alcohol abuse, and HIV/aids.

Statistical analysis:

Inverse probability weighting estimation

We first used a multinomial logistic regression to estimate each primary care model´s probability of existing in a specific geographical area. The use of this type of regression is justified by the fact that there is not an ordered relationship between the predictors and the type of primary care provision model. As mentioned above, the opening of FHU was based on a voluntary basis by the healthcare professionals, without any specific geographic criteria or population needs assessment. We might expect that their opening was conditional on the demographic and socioeconomic characteristics of the geographical area in which they were established, and therefore different parts of the population will have unequal probabilities of being covered by each primary care provision model.[157] As a consequence, individuals from the PHCU, FHU-A, and FHU-B may not be comparable in terms of their health outcomes, to the extent that any observed differences in these health outcomes may simply reflect their underlying differences (e.g. they are older, poorer, or sicker), rather than the effects caused by the type of primary care provision.[158]

This bias can be attenuated by performing a weighted estimation, by giving to each primary care provision model a weight inversely proportional to its probability of existing in a specific geographic region (i.e. inverse probability weighting).[157] First, the probability of a given primary care provision model was estimated from the multinomial logistic regression (propensity score) and then the inverse of this probability was computed. As a result, the primary care models with a high predicted probability to exist in a less favourable socioeconomic geographic area received a lower weight, compared with those with a low predicted probability.[158] This “weight” was used in the next analysis to estimate a weighted regression model.

Negative binomial regression

We modelled the total number of emergency department visits as a function of the organizational model of primary care, year, sociodemographic, and clinical characteristics of the patients, using a negative binomial regression. The negative binomial regression is justified by the over-dispersion of our dependent variable, in which the conditional variance exceeds the conditional mean.[159] We estimated this model without (Regression I) and with the inverse probability weighting (Regression II).

Subsequently, in the Regression II each patient´s contribution to the emergency department visits is weighted based on the inverse of his probability of belonging to each of the primary care provision models, conditioned on the previously set variables believed to influence an emergency department visit.[160] In doing this, we corrected the predicted number of emergency department visits in each primary care provision model by giving less weight to those individuals with a high probability of belonging to a PHCU, and therefore, to a less favourable socioeconomic geographic area.[158]

We then calculated the hypothetical number of emergency department visits if all patients from the PHCU were assigned to an FHU-A or to an FHU-B, by estimating the predictive margins, and the total number of emergency department visits that could be avoided by this shifting. Finally, we calculated the total hypothetical savings to the Portuguese NHS, by multiplying these "avoidable" emergency department visits by the official tariffs of the emergency department visits published by the Ministry of Health.[156]

Results

Since the beginning of the primary care reform in 2006, FHU have opened each year across Portugal. In 2015 about half of the Portuguese population was covered by a PHCU (n=4,660,802) of which 1,097,208 had no designated general practitioner. The other half of the population was distributed within the FHU: n=2,365,905 in FHU-A and n=2,792,990 in FHU-B.[161] By definition of the FHU model, all patients covered by FHU should have a designated general practitioner; nevertheless, some patients may not have one temporarily, perhaps due to physicians' migration or retirement.

The population served by the FHU-A has a lower proportion of elderly (β=-0.03, $p<0.01$), lower rates of mortality by specific diseases, a higher proportion of people with tertiary education (β=0.02, $p<0.01$), and higher purchasing power (β=0.01, $p<0.01$), in comparison to the population served by the PHCU (Table 11). These results are overall similar for the FHU-B compared to PHCU and show that generally FHU are located in less disadvantaged geographic regions.

Table 11. Multinomial logistic regression for each primary care model´s probability of existing in a specific geographical area, conditional on the demographic and socioeconomic characteristics of the population that they cover (2010-2015).

Primary care provision model	Coef.	(95% CI)	
PHCU	Ref.		
FHU-A			
Year			
2010	Ref.		
2011	0.18	(-0.08;	0.45)
2012	0.36**	(0.09;	0.63)
2013	0.49***	(0.22;	0.76)
2014	0.67***	(0.40;	0.94)
2015	0.74***	(0.47;	1.01)
Demographic characteristics			
Proportion of elderly (≥ 65 years) (%)[a]	-0.03***	(-0.05;	-0.01)
Proportion of males (%)[b]	-0.04*	(-0.08;	0.00)
Heart disease mortality rate per 1,000 inhabitants[c]	-0.60***	(-0.89;	-0.32)
COPD mortality rate per 1,000 inhabitants[c]	-0.51***	(-0.75;	-0.26)
Diabetes mortality rate per 1,000 inhabitants[c]	-0.97***	(-1.42;	-0.51)
Socioeconomic characteristics			
Proportion of people with tertiary education (%)[b]	0.02***	(0.01;	0.03)
Purchasing power[c]	0.01***	(0.00;	0.01)
FHU-B			
Year			
2010	Ref.		
2011	0.17	(-0.13;	0.47)
2012	0.61***	(0.30;	0.91)
2013	0.74***	(0.44;	1.04)
2014	1.01***	(0.71;	1.31)
2015	1.16***	(0.86;	1.46)
Demographic characteristics			
Proportion of elderly (≥ 65 years) (%)[a]	-0.07***	(-0.10;	-0.05)
Proportion of males (%)[b]	-0.05**	(-0.09;	0.00)
Heart disease mortality rate per 1,000 inhabitants[c]	-1.85***	(-2.23;	-1.48)
COPD mortality rate per 1,000 inhabitants[c]	-1.20***	(-1.52;	-0.87)
Diabetes mortality rate per 1,000 inhabitants[c]	-0.03	(-0.55;	0.50)
Socioeconomic characteristics			
Proportion of people with tertiary education (%)[b]	0.05***	(0.04;	0.06)
Purchasing power[c]	0.01***	(0.00;	0.01)

*** p<0.01; ** p<0.05; * p<0.1; [a] Data from 2010 a 2015 at a parish level; [b] Data from 2011 Census at a parish level; [c] Data from 2010 to 2015 at a municipality level.

Overall, between 2013 and 2015 there were 18,501,803 emergency department visits (about 6,167,268 per year) by 9,203,817 patients, which accounts for two emergency department visits per patient on average (Table 12). The majority of patients that went to an emergency department were female (54.9%) and exempt from co-payments (60.8%). Almost 13% of the emergency department visits led to an inpatient admission and the most frequent pre-existing comorbidity was hypertension (22.4%). Overall, the number of patients who used emergency department services was similar across the three years. Regarding the primary care provision model, the majority of patients that went to an emergency department were registered in a PHCU (52.7%) and of these about 22.5% had no designated general practitioner. Concerning the FHU-A and FHU-B, this percentage fell to 1.7% and 1.0%, respectively. The average number of emergency department visits per patient in each primary care provision model was 2.05, 2.00, and 1.94 for PHCU, FHU-A, and FHU-B, respectively.

If we take into account the number of patients registered in the different primary care provision models in 2015 (n=4,660,802 in PHCU, n=2,365,905 in FHU-A, and n=2,792,990 in FUP-B) and the total number of people who went to an emergency department in the same year, the percentage of emergency department users by primary care provision model was 33%, 32%, and 27% in the PHCU, FHU-A, and FHU-B, respectively.

The results from the unweighted regression (Regression I, Table 13) show that being registered in an FHU-A, or in an FHU-B was significantly associated with a lower probability of having an emergency department visit, of 3% (IRR=0.97, $p<0.01$) and 7.0% (IRR=0.93, $p<0.01$), respectively, in comparison to being registered in a PHCU. The results from the weighted regression (Regression II, Table 13) confirmed this result, although the IRR were slightly higher, being IRR=0.98 ($p<0.01$) and IRR=0.94 ($p<0.01$) for FHU-A and FHU-B, respectively, in comparison to PHCU.

The results from regression II (Table 13) also show that having a designated general practitioner is not associated with the probability of having an emergency department visit (IRR=1.00), even though the result is statistically significant ($p<0.01$). Being male was linked to a lower probability of having an emergency department visit IRR=0.96 ($p<0.01$); and being exempt of the co-payment and having a more severe episode was linked to a higher probability of having an emergency department visit: IRR=1.28 ($p<0.01$) and IRR=1.52 ($p<0.01$), respectively. In addition, having a pre-existing comorbidity increases the probability of having an emergency department visit. Finally, we verify that the number of emergency department visits increased slightly in 2014 (IRR=1.02 $p<0.01$) and 2015 (IRR=1.02 $p<0.01$) in comparison to 2013.

Table 12. Characteristic of the patients that had at least one emergency department visit between 2013 and 2015, by primary care provision model, in Portugal

Primary care provision model	Overall		PHCU	FHU-A	FHU-B
Total number of patients	9,203,817		4,851,718	2,128,059	2,159,178
Total number of ED visits	18,501,803		9,937,546	4,251,571	4,185,874
Mean number of ED visits per patient	2.01		2.05	2.00	1.94
Patient characteristics	**n**	**%**	**%**	**%**	**%**
	9,203,817	100	52.7	23.1	23.5
Without general practitioner					
	1,178,337	12.8	22.5	1.7	1.0
Year					
2013	3,086,814	33.5	35.3	31.7	31.5
2014	3,052,433	33.2	33.2	33.3	33.2
2015	3,064,570	33.3	31.5	35.0	35.4
Sociodemographic characteristics					
Age (mean)	41.3 (26.2)		42.3 (26.4)	40.7 (26.0)	39.4 (25.8)
Male	4,150,710	45.1	45.3	44.7	44.9
Exemption of co-payment	5,596,267	60.8	60.3	61.6	61.6
Severity (proxy)					
Number of ED that led to hospitalization	1,175,861	12.8	13.1	12.3	12.4
Comorbidities					
Diabetes	797,341	8.7	8.7	8.9	8.3
Hypertension	2,057,502	22.4	22.3	23.4	21.8
Neoplasm	374,908	4.1	3.7	4.5	4.5
Asthma	252,018	2.7	2.2	3.1	3.6
COPD	155,676	1.7	1.5	1.9	1.9
Depression	908,147	9.9	8.5	11	12
Anxiety	555,805	6.0	5.2	6.6	7.4
Smoker	761,130	8.3	5.7	10.4	12.2
Alcohol abuse	129,155	1.4	1.1	1.6	1.8
HIV/aids	18,769	0.2	0.2	0.3	0.3

ED – emergency department

Table 13. Negative binomial regression for the number of emergency department visits between 2013 and 2015, in Portugal

	Regression I (unweighted)			Regression II (weighted)		
Number of ED visits	IRR	(95% CI)		**IRR**	**(95% CI)**	
Organizational model						
PHCU	1			**1**		
FHU-A	0.97***	(0.96;	0.97)	**0.98*** **	**(0.98;**	**0.98)**
FHU-B	0.93***	(0.93;	0.93)	**0.94*** **	**(0.94;**	**0.94)**
With general practitioner	1.00***	(0.99;	1.00)	**1.00*** **	**(1.00;**	**1.01)**
Year						
2013	1			**1**		
2014	1.02***	(1.02;	1.02)	**1.02*** **	**(1.02;**	**1.02)**
2015	1.01***	(1.01;	1.01)	**1.01*** **	**(1.01;**	**1.02)**
Sociodemographic characteristics						
Age	1.00***	(1.00;	1.00)	**1.00*** **	**(1.00;**	**1.00)**
Male	0.96***	(0.96;	0.96)	**0.96*** **	**(0.95;**	**0.96)**
Exemption of co-payment	1.29***	(1.29;	1.29)	**1.28*** **	**(1.28;**	**1.28)**
Severity (proxy)						
Number of ED that led to hospitalization	1.52***	(1.52;	1.52)	**1.52*** **	**(1.52;**	**1.52)**
Comorbidities						
Diabetes	1.00***	(0.99;	1.00)	**0.99*** **	**(0.99;**	**1.00)**
Hypertension	1.03***	(1.03;	1.04)	**1.03*** **	**(1.03;**	**1.03)**
Neoplasm	1.07***	(1.07;	1.07)	**1.07*** **	**(1.06;**	**1.07)**
Asthma	1.10***	(1.09;	1.10)	**1.09*** **	**(1.09;**	**1.10)**
COPD	1.16***	(1.15;	1.16)	**1.16*** **	**(1.15;**	**1.17)**
Depression	1.10***	(1.10;	1.10)	**1.10*** **	**(1.09;**	**1.10)**
Anxiety	1.09***	(1.08;	1.09)	**1.08*** **	**(1.08;**	**1.09)**
Smoker	1.03***	(1.02;	1.03)	**1.03*** **	**(1.02;**	**1.03)**
Alcohol abuse	1.11***	(1.10;	1.11)	**1.11*** **	**(1.10;**	**1.11)**
HIV/aids	1.15***	(1.13;	1.16)	**1.15*** **	**(1.13;**	**1.17)**

*** p<0.01
IRR – incidence rate ratio
ED – emergency department
Note: the chi-squared value of the likelihood ratio test that compares the negative binomial regression to a Poisson model is 4.1e+05 (p<0.01), which strongly confirms that the negative binomial model is the most appropriate.[159]

In order to estimate the hypothetical savings that would be obtained if all patients from the PHCU were registered in an FHU-A or in an FHU-B, we first estimated the number of emergency department visits if all patients from the PHCU were assigned to an FHU-A or to an FHU-B using predictive margins.[162] By setting every observation from PHCU to FHU-A, the predicted number of emergency department visits by patient per year drops from 2.05 to 2.00, and to 1.92 visits when we set the PHCU observations as FHU-B (Table 14). Using data from the last year available (2015) we estimated the number of potentially avoidable emergency department visits by multiplying the difference in the average number of emergency department visits by the total number of people registered in a PHCU who went to an emergency department visit in 2015 (n=1,529,575). The number of potentially avoidable emergency department visits was estimated at 81,432 and 194,898 visits if we shifted people from PHCU to FHU-A or to FHU-B, respectively. Using official tariffs,[156] this accounted for a potential saving of about 6,800,000 € or 16,200,000 € per year, respectively (Table 14).

Table 14. Predicted margins for the emergency department visits by organizational model of primary care and hypothetical savings, in Portugal, 2013-2015

	PHCU → FHU-A	PHCU → FHU-B
Predicted number of emergency department visits	2.00	1.92
Number of potentially avoidable emergency department visits per year	81,432	194,898
Potential savings per year (in euros €)	≈ 6,800,000	≈ 16,200,000

Discussion

Key finding and interpretation:

First, our study confirms that there is an unequal distribution of FHU across Portugal. Based on the population characteristics covered by each of the organizational models, we verified that FHU opened in socioeconomically favoured geographical areas. Therefore, FHU may have unintendedly caused asymmetries in access to primary care, and enhanced asymmetries in the quality of services provided, inducing greater inequalities in the provision of primary care. In the 2015 OECD Review of Health Care Quality, two potential solutions for the Portuguese primary care reform are suggested, from an equity point of view: the establishment of a date by which all PHCU must transit into FHU; or the introduction of some quality performance incentives in PHCU.[27]

Second, our study suggests that even after taking into consideration the more favourable characteristics of the population covered by FHU-A and FHU-B, the patients assigned to these primary care models have a significantly lower probability of having an emergency department visit in comparison to those registered in a PHCU. Earlier studies found that the ability to make an appointment with a particular general practitioner,[87,88] better access,[81–83,149] and better continuity of care in primary care,[84–86] was associated with a lower number of emergency department visits, and that a greater dissatisfaction with services at other levels of care, especially with the characteristics of the primary care [154] and difficulties in timeliness, access, and service provision in primary care were associated with more emergency department visits. For example, Amiel et al. (2014) found that 20% of surveyed patients attending an emergency department with "minor illness" had been unable to obtain a timely general practitioner appointment.[163] Also a study performed in 2001 in a Portuguese University Hospital showed that 31% of all emergency department visits were inappropriate, and the authors point to the lack of timely primary care as the main reason.[164] We found that patients assigned to FHU provision models had a lower probability of having an emergency department visit. This link may be related to the underlying characteristics of the FHU such as better quality,[165] quicker access, and more continuity of care (i.e. having a long-term relationship with the physician, who is responsible for their overall health and healthcare).[40] In addition, we found that having an general practitioner was not significantly linked to the probability of having an emergency department visit, when adjusted for the type of primary care provision model. This may be due to the very low percentage of people without general practitioners in FHU. Note that in 2015 there were about 1 million people without a general practitioner, assigned to PHCU.[30]

Third, we found that patients covered by the FHU-B have the lowest number of emergency department visits from the three primary care provision models. FHU-A and FHU-B are both characterized by small multidisciplinary teams who have functional and technical autonomy, with the difference that health professionals in the FHU-B are partly financed through individual incentives, which can reach up to 30% of total physician remuneration (the rest is salary-based).[27] Finally, we estimated a potential savings of about 16,200,000 € a year, if we shifted people from PHCU to FHU-B. Even though these results could be, in part, linked to the pay-for-performance scheme in primary care, in the sense that we are in fact paying more for better access and quality, note that these savings do not take into account the investment needed to transform PHCU to FHU-B. This brings to attention the need to evaluate if these additional payments compensate for the health outcomes gained, in a cost-effectiveness perspective.

Limitations:

This study has some limitations that should be addressed. First, any method that uses propensity scores for weighting to remove confounding can only correct the observations for the observed covariates. Therefore, as in any regression model that uses covariates for adjustment, propensity scores requires that all relevant confounders be included in the model.[166,167] We used demographic and socioeconomic covariates of the population covered by each of the primary care provision models that are known to influence emergency department visits, but there may be other baseline differences between the groups that were not taken into account, that may influence the presence of an FHU in a specific geographical area.

Second, in the same line, it would be desirable to measure the yearly evolution of the emergency department visits before and after the primary care reform, in order to estimate a causal link between FHU on the reduction of emergency department visits. However, the Central Administration of the Health System made data regarding emergency department visits available to us only from 2013 to 2015. Therefore, we were able to analyse only the risk of having an emergency department visit conditional to the primary care provision model in which the patient is registered.

Third, we did not have information about the Manchester Triage System of each emergency department visit, so that we could not perform a stratified analysis based on the severity of the emergency department episodes in each of the primary care provision models, and to identify, to some extent, the inappropriate use of emergency department. There is evidence that inappropriate patient behaviour can influence emergency department visits. Studies from Portugal[27] and Italy[154] showed that emergency departments are being used as an alternative to primary care for non-emergency routine needs due to the speed of treatment, convenience, and for a “one stop shop” for diagnostic tests and specialist consultations, leading in many cases to a saving in time and money for the patient, but leading to an overuse of resources and higher costs of the healthcare system. Also, in England, Salisbury et al. (2002) found that even patients with a registered general practitioner still use emergency department services due to speed of access and convenience, reflecting this inappropriate patient behaviour.[163] We used the variable “number of emergency department visits that lead to an inpatient episode” to try to overcome this issue and to adjust for the severity of the emergency department visit, by using a proxy, but we are not able to quantify the number of false emergency department visits, nor their underlying reason.

Conclusion

The new organizational model of primary care provision in Portugal suggests a lower emergency department utilization by their assigned patients, with potential savings. However, this current way of primary care organization possibly causes asymmetries in access and in the quality of services provided, raising concerns of the reforms´ induced inequalities in the provision of primary care. Full coverage of the Portuguese population by general practitioners is crucial in order to reduce the inequalities in access to primary care, and an evaluation in a cost-effectiveness perspective of the new primary care provision model should be conducted in order to assess whether the health gains compensate for the investment.

Highlights

- Pay-for-performance in primary care was introduced in Portugal in 2006.
- Half of the population is assigned to primary care units with pay-for-performance.
- Patients assigned to those units have a lower emergency department utilization.
- There are potential inequalities in the access to primary care in Portugal.

Acknowledgements

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4.2.2. Effect of a national primary care reform on avoidable hospital admissions (2000-2015): a difference-in-difference analysis.

Klára Dimitrovová[1], Julian Perelman[1,2], Manuel Serrano-Alarcón[1]

[1] Escola Nacional de Saúde Pública, Universidade NOVA de Lisboa. Lisbon, Portugal

[2] Centro de Investigação em Saúde Pública, Escola Nacional de Saúde Pública, Universidade NOVA de Lisboa. Lisbon, Portugal

Abstract

In 2006 a major primary care reform was initiated in Portugal. The most significant aspect of this reform was the creation of a new organizational model of primary care provision: Family Health Units, consisting of small voluntarily constituted multidisciplinary teams that have functional autonomy and are partly financed through capitation and pay-for-performance. The objectives of this study are to evaluate the impact of this reform on population health outcomes, measured by the rate of ambulatory care sensitive conditions (ACSC), i.e. avoidable hospital inpatient admissions, and to explore the effectiveness of the pay-for-performance in primary care by analysing the subset of disease specific ACSC related to the financial incentives. Using data from 276 Portuguese municipalities from 2000 to 2015 (n=4,416) and exploiting the gradual introduction of the primary care reform over time, we used a difference-in-differences approach contrasting the evolution of the rate of ACSC in municipalities that adopted or not the reform. We then explore heterogeneous effects by incentivized (diabetes and hypertension) and non-incentivized disease-specific rates of ACSC. During the period under analysis, 448 Family Health Units were created in 126 municipalities. Results show that the primary care reform did not significantly reduce the rate of ACSC or the rate of incentivized ACSC. The Portuguese primary care reform sought to increase access to care and to chronic disease management by improving the long-term relationship between health professionals and patients. Our results suggest that the primary care reform did not significantly alter health outcomes, even for the diseases for which financial incentives were in place.

Key words: Primary care, pay-for-performance, incentives, difference-in-difference, ambulatory care sensitive conditions, Portugal, family health units

Introduction

The quality of primary care is one of the key factors of an effective and efficient health system. Studies show that stronger primary care services help to reduce major causes of death and disorders, and are essential to ensure disease prevention, early diagnosis, and adequate referral to secondary care.[11,36]

Health policies that strengthen primary care have therefore been encouraged worldwide and, consequently, many countries have undergone recent primary care reforms in order to reduce the number of hospital emergency visits and avoidable inpatient admissions.[42,79] Increasing the hours of primary care service, creating or expanding the availability of urgent primary care services, establishing general practitioners home visits, and improving the coordination of primary care and emergency care, are some of the measures adopted in many European countries.[21] Also, the introduction of pay-for-performance in primary care has been widely implemented, even though the overall evidence of its effectiveness is mixed and often conflicting.[46,168,169]

The financial incentives linked to quality of care are generally designed for improving processes of care (e.g. blood pressure checks) and intermediate outcomes (e.g. cholesterol control in people with diabetes) rather than for improving patient health outcomes. Studies found that the impact of pay-for-performance on processes of care and intermediate outcomes was often modest[19,25] and can even have unintended detrimental consequences on quality of care for patients with non-targeted conditions.[170] Studies have rarely focused on the improvements in health outcomes and those that did have found little or no impact in this indicator.[25,46,171]

The largest and most evaluated pay-for-performance scheme in primary care is the "Quality and Outcomes Framework", implemented at a national level in the United Kingdom in 2004, which rewards general practitioners´ based on the quality in the delivery of primary care.[19,20] Several studies showed that this payment mechanism was accompanied by a rapid improvement in the indicators associated with financial incentives[172,173], but also showed that this improvement was limited in time.[19,174] More recently, Ryan et al. (2016), using a difference-in-difference analysis and synthetic control methods, found that this reform was not associated with significant changes in population health outcomes, as measured by the mortality rate, between 1994 and 2010.[20] However, in another study, Harrison et al. (2014) reported a decrease in incentivized ambulatory care sensitive conditions (ACSC) as compared with conditions that were not incentivized, suggesting a positive effect of the pay-for-performance in the reduction of avoidable hospitalizations.[25] In a nutshell, there is a lack of knowledge of whether pay-for-performance in primary care enables real improvements in populations'

health outcomes, while, surprisingly, these models are increasingly implemented worldwide. In Portugal, a primary care reform with characteristics and rationale close to those in the United Kingdom was implemented in 2006, and is still ongoing in 2018.

The Portuguese Primary Care reform:

Portugal has a National Health Service (*Serviço Nacional de Saúde)* with a strong gatekeeping system. Primary care was traditionally provided in primary care centres, in which general practitioners worked in solo practice and were paid fixed salaries. In 2006, a major primary care reform was initiated in order to improve access, quality, and satisfaction, and to strengthen primary care. The organization of primary care centres was redefined, and several models of primary care provision were created.[27]

The most significant aspect of the primary care reform was the creation of Family Health Units (FHU) *(Unidades de Saúde Familiar),* which consisted of voluntarily constituted multidisciplinary teams of 20 health professionals, on average (general practitioners, nurses, and administrative technicians), enjoying functional and technical autonomy, and partly financed through capitation and pay-for-performance. This pay-for-performance is based on a series of performance indicators, mainly related to child and maternal health, cancer screening, vaccination, and diabetes and hypertension management,[28] and can take the form of team-based institutional incentives or individual financial incentives, which depend on the achievement of specific incentivized performance indicators. There are two models of FHU: model A and model B. All FHU start as model A and must prove a specific level of quality, and clinical and functional targets, before they are allowed to apply for transition to model B. Both models have team-based institutional incentives that correspond to monetary incentives but can only be used, for example, for the development of key infrastructure, purchase of equipment, or for the completion of specific professional training.[29] Additionally, in FHU model B there are individual financial incentives for all staff (supplementary payments) which are a variable component of the remuneration process (the rest is a fixed legislated salary). Note that these incentives can reach up to 30% of total physician remuneration, and up to 10% for nurses.[27]

All patients covered by FHU are entitled to a designated general practitioner named “family physician”, which should allow for better access and better continuity of care, due to a longer-term relationship with the patient. Quality was also expected to be enhanced by the multidisciplinary nature of the practice, its longer opening hours, and possibility to schedule visits more easily. This new provision model was expected to ultimately

improve health outcomes, through better prevention and follow-up, and also to reduce the use of secondary care.[27]

Since 2006 there has been a progressive expansion of FHU across Portugal, which, because it was based on self-selection of health professionals, was unrelated to any specific geographic criteria or population needs assessment. Consequently, the population started to be covered or not by an FHU depending on whether a new FHU was created in their area of residence. Also, since 2006, the term "primary care centre" was discontinued and the health professionals that did not join the FHU model automatically became part of the Personalized Health Care Units (PHCU) (*Unidades de Cuidados de Saúde Personalizados),* which differed from FHU in staff size, facilities, and payment mechanisms (without pay-for-performance), thus remaining very similar to the traditional "primary care centres".[27] Despite the primary care reform, at the beginning of 2019 full coverage of the Portuguese population by a general practitioner still did not exist, with 707,283 (6.97%) persons without a general practitioner.[30] All of these patients were assigned to the PHCU. This current way of primary care organization possibly causes many asymmetries in access in the quality of services provided, raising concerns about the reform's induced inequalities in the provision of primary care.

Some available data suggest that FHUs are performing better than the PHCU in the quality of care delivered, as measured by the improvement in processes of care (e.g., "blood pressure checks" and "diabetes checks").[28] However, to date no study has investigated the impact of the primary care reform on patient health outcomes.

In this paper we analyse if the Portuguese primary care reform (i.e. the creation of FHUs) affected patient health outcomes, as measured by the rate of ambulatory care sensitive conditions (ACSC). Specifically, by exploiting the fact that FHUs were created in different municipalities and years, we seek to assess their impact on the rate of ACSC over the 2000-2015 year period.

ACSC are defined as specific conditions for which hospitalization is thought to be avoidable through patient education, health promotion initiatives, early diagnosis, early treatment, and appropriate chronic disease management, i.e., "timely and effective primary care".[59] ACSC are largely studied as an indirect measure of access to effective primary care and therefore we would expect that the reform should have a direct effect on this indicator. Furthermore, we aim to contribute to the international literature on the effectiveness of pay-for-performance in primary care, by analysing the impact of the primary care reform in the subset of ACSC related to the incentivized indicators. This approach has been used by other authors.[25,175–177]

Methods

Data sources:

We used data on all in-patient stays at all public non-specialized Portuguese NHS hospitals for the years 2000 to 2015, and data on the number and geographical location (municipality) of all FHUs that opened in Portugal during the 2006-2015 period, made available by the Portuguese Central Administration of the Health System.

We also used aggregate socioeconomic data from the National Institute for Statistics for the 2000-2015 period.[178] Our total number of observations was 4,416, which corresponds to 276 of the 278 municipalities in mainland Portugal from 2000 to 2015. We excluded two municipalities due to lack of data on the ACSC (0.72% of the sample).

Variables:

We first used the overall rate of ACSC per 1,000 adult inhabitants (≥18 years old) as our dependent variable. This rate was calculated as follows: first we selected from all in-patient stays the episodes classified as ACSC and valid for adult population, using the set of guidelines defined by the Agency for Healthcare Research and Quality.[57] Then, using information from the patients´ residence geographic code, we calculated the total number of ACSC per municipality and year and then calculated the rate of ACSC per 1,000 adult inhabitants. There are 12 separate ACSC in this overall rate (Table 15).

For the second part of the analysis we used as dependent variables disease-specific rates of ACSC related to the incentivized clinical areas of the FHU. As mentioned above, between 2006 and 2015, in both FHUs (model A and model B) the team-based institutional incentives and individual financial incentives were based on a series of performance indicators mainly related to child and maternal health, cancer screening, vaccination, and diabetes and hypertension management, defined at a national level and equal for all FHUs (Table A2 and A3 in Appendix II).[179] We focused our analysis on the incentivized conditions that are ambulatory care sensitive, i.e. diabetes and hypertension management. Thus, from the 12 individual ACSC defined by the Agency for Healthcare Research and Quality, we created four groups of disease-specific ACSC, two of them related to the incentivized areas of the pay-for-performance (diabetes-related ACSC and circulatory-related ACSC) and two related to the non-incentivized areas of the pay-for-performance (respiratory-related ACSC and urinary tract infection ACSC), as illustrated in Table 15.

Note that even though the incentivized indicators are related to hypertension management, we added to this group the conditions that are directly related to high blood pressure such as heart failure and angina, and therefore also indirectly targeted in the

pay-for-performance. This grouping was also necessary because the number of ACSC due only to hypertension was too low in the period under analysis to be analysed as a separate category. Finally, the ACSC due to dehydration was not included in the analysis since the number of hospitalizations due to this condition was too low in the period under analysis.

Table 15. Incentivized and non-incentivized ambulatory care sensitive conditions under the pay-for-performance scheme in primary care in Portugal (2006-2015).

	Disease-specific ACSC	**Individual ACSC defined by AHRQ[1]**
Incentivized ACSC	Diabetes-related ACSC	diabetes short-term complications
		diabetes long-term complications
		uncontrolled diabetes
		lower-extremity amputation diabetes
	Circulatory-related ACSC	hypertension
		heart failure
		angina without procedure
Non-incentivized ACSC	Respiratory-related ACSC	COPD or asthma in older adults
		asthma in younger adults
		bacterial pneumonia
	Urinary tract infection ACSC	urinary tract infection
	-	dehydration[2]

[1] These 12 conditions are included in the overall rate of ACSC. [57]
AHRQ - Agency for Healthcare Research and Quality
[2] Note that "dehydration" was not analysed as a separate category.

To control for population characteristics we used the municipality year-level purchasing power, and the proportion of elderly (65 or older), since studies show that ACSC are mostly prevalent at older ages, especially after the age of 65 years,[54] and that people from low-income areas have a much higher risk of being hospitalized for these conditions.[1,49,74] In Portugal the municipality purchasing power (which is a compound indicator that measures the relative purchasing power per capita based on a series of indicators, such as the gross income per capita) is calculated bi-annually, so for the in-between years we used average values. We also controlled for the number of inhabitants in each municipality and year to account for the likelihood of an FHU being less likely to be opened in very small municipalities. Additionally, we controlled for regional differences, i.e. for the five Regional Health Administrations, since these administrations are responsible for the management of some dimensions of primary care and for regional health policies´ implementation.

Finally, our treatment variable is a dummy indicating whether a municipality underwent the primary care reform during the period under analysis, i.e., it ever had or ever will have an FHU open during the period 2006-2015 (adopting municipality *vs.* non-adopting municipality).

Empirical strategy:

Overall impact of the implementation of the primary care reform

To estimate an average overall effect of the primary care reform on health outcomes at municipality level, we used a difference-in-differences (DiD) analysis by contrasting the evolution of the rate of ACSC in adopting and non-adopting municipalities, as follows:

$$y_{mrt} = \beta_0 + \beta_1(PC\ Reform_{mr}\ x\ After_{mrt}) + \beta_2 Year_t + \beta_3 Municipality_m + \beta_4 RHA_r + \beta_5(Year_t\ x\ RHA_r) + \beta_6 X_{mrt} + \in_{mrt}$$

(Equation 1)

where: *m* stands for municipality, *r* for Regional Health Administrations, and *t* for time period (year). y_{mrt} is each of our outcome variables (rate of total ACSC per 1,000 inhabitants or rate of disease-specific ACSC per 1,000 inhabitants) in each municipality *m* of each region *r* in year *t;* $PC\ reform_{mr}$ equals one if the municipality will ever have an FHU open during the 2006-2015 period (i.e., adopting municipalities); $After_{mrt}$ equals one if the municipality has at least one FHU open at year *t*; $Year_t$ are year fixed effects; $Municipality_m$ are municipality fixed effects; RHA_r are Regional Health Administrations fixed effects; $Year_t\ x\ RHA_r$ are regional-specific time trends; X_{mrt} are covariates representing the characteristics of each municipality that vary over year: purchasing power, proportion of elderly, and number of inhabitants; and $\in_{mrt}$ is the random error term. β_1 aims to measure the overall effect of the reform on the average rate of ACSC.

There are two main concerns in our analysis. The first is that the opening of FHUs was not random over municipalities and time. Note that the FHUs were voluntarily created by groups of health professionals, so we would expect that their opening may depend on some pre-existing characteristics of the municipality. Actually, descriptive analysis shows that FHUs have opened mainly in urban municipalities with a lower proportion of elderly and higher purchasing power (Table 16). To deal with this concern, and following the approach used in similar studies,[180,181] we included demographic and socioeconomic control variables at the municipality level and used municipality fixed-effects in order to account for any other pre-existing differences across municipalities.

Standard errors were clustered at the municipality level in all of our models, to account for the possible serial correlation in the error terms, and to avoid overestimation

of the significance of estimated coefficients.[182] Moreover, we added regional-specific time trends to account for the differences in regional health policies´ implementation.

The second major concern is the *parallel trends assumption*. The main DiD assumption implies that the pre-existing trends in the rate of ACSC in both groups of municipalities be parallel before the implementation of the primary care reform, conditional on the set of municipality characteristics that we control for.[183] In order to test for this assumption, we included leads in our model, following other authors.[180,183–185]

Therefore, to test for the parallel trend assumptions, our second DiD model is represented as follows:

$$y_{mrt} = \beta_0 + \beta_1(PC\ Reform_{mr}\ x\ After_{mrt}) + \sum_{k=1}^{5} \beta_k PC\ Reform\ before\ k\ periods_{mrt} + \beta_2 Year_t + \beta_3 Municipality_{mr} + \beta_4 RHA_r + \beta_5(Year_t\ x\ RHA_r) + \beta_6 X_{mrt} + \in_{mrt}$$

(Equation 2)

where:$PCReform\ before\ k\ periods_{mrt}$ is a dummy variable that equals 1 if the municipality *m* in year *t* will start the reform in *k* years (leads). These are dummy variables for the adopting municipalities for each year before the reform, up to 5 years, with the base category being 6 or more years before the reform. If our data followed the parallel assumption, coefficients of the leads (β_k) should not be significant, suggesting that there were no differences in trend between adopting and non-adopting municipalities prior to the reform.

As further reported in the results section, our data do not follow the parallel trend assumption, which means that the adopting and non-adopting municipalities already had a different trend of the rate of ACSC before the primary care reform. To deal with this issue, we added municipality-specific time trends to our model. In this way we allow for each municipality to follow its own overall linear trend and we can be assured that we are controlling for all time-varying factors at the municipality level that could bias our results.[186] Therefore, our main DiD model is the following:

$$y_{mt} = \beta_0 + \beta_1(PC\ Reform_m\ x\ After_{mt}) + \beta_2 Year_t + \beta_3 Municipality_m + \beta_4(Municipality_m\ \mathrm{x}\ trend_t) + \beta_5 X_{mt} + \in_{mt}$$

(Equation 3)

where: *trend* is a linear trend (i.e., equals 1 in 2000, 2 in 2001, and so on). Note that in Eq. 3 region-specific trends are not needed since they would be captured by the municipality-specific trends.

Finally, we included "lags" in our model to explore the dynamic effect of the primary care reform over time, by indicating the number of years that each municipality has been under the primary care reform. Specifically, we added dummies in the adopting municipalities that indicate if the primary care reform has been implemented for one year, two years, three years, and so on, up to ten years, in order to account for the entire period between 2006 and 2015. This will allow us to determine if the effect of the primary care reform is temporary or persistent over time, while we still control for the municipality pre-existing time trends.[180,181,184,187] Hence, we estimate the final following equation:

$$y_{mt} = \beta_0 + \sum_{k=1}^{10} \beta_k PC\ Reform\ in\ effect\ for\ k\ periods_{mt} + \beta_2 Year_t + \beta_3 Municipality_m + \beta_4 (Municipality_m \text{ x } trend_t) + \beta_5 X_{mt} + \in_{mt}$$

(Equation 4)

where: $PCReform\ in\ effect\ for\ k\ periods_{mt}$ is a dummy variable that equals 1 if the municipality *m* in year *t* has been under the reform for *k* years (lags).

Results

Descriptive analysis:

Between 2006 and 2015, 448 FHUs were created in 126 municipalities. As a result, in 2015 there was an average of 0.67 FHU (min. 0.14; max. 1.79) per 10,000 inhabitants in the municipalities under the reform, and 152 municipalities without any FHU. Official records show that approximately half of the Portuguese population (5 million inhabitants) was assigned to an FHU in 2015.[30]

Rate of ACSC per 1,000 inhabitants

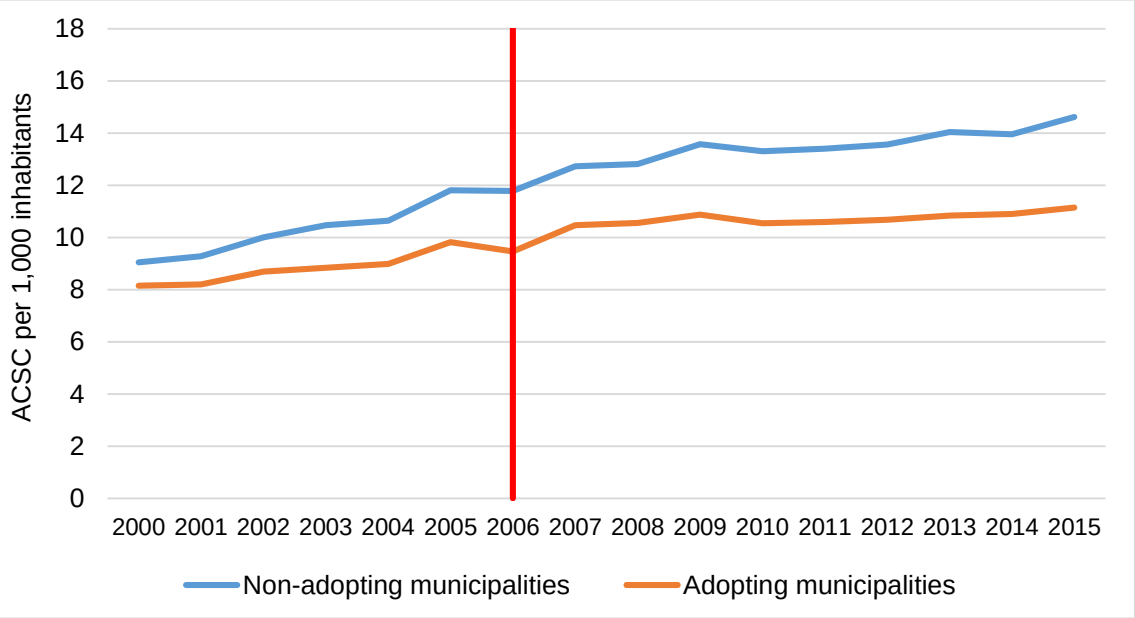
The average rate of ACSC during the study period was 11.2 per 1,000 inhabitants (9.9 in adopting municipalities *vs.* 12.2 in non-adopting municipalities) (Table 16). Figure 5 shows that the primary care reform was adopted by municipalities that already presented better health outcomes, as measured by the rate of ACSC. It also shows that the rate of ACSC has continuously increased over the last 16 years. However, the slope seemed already higher in non-adopting municipalities prior to the primary care reform, suggesting that the parallel trend assumption is unlikely to hold. Note that the FHUs did not all open at a single moment in 2006, as they were gradually implemented over time and across municipalities.

Table 16. Socioeconomic characteristics of the population in adopting and non-adopting municipalities of the primary care reform (2000-2015)

Population characteristics Average (S.D.)	Adopting municipalities (with FHU) [n=126]	Non-adopting municipalities (without FHU) [n=152]	*t-test*
Inhabitants	64,483 (75,318)	12,151 (10,011)	p<0.01
Percentage of elderly	18.4 (4.7)	26.4 (5.8)	p<0.01
Purchasing power	86.6 (27.7)	65.8 (15.5)	p<0.01
ACSC rate (per 1,000 adult inhabitants)[1]	9.92 (0.1)	12.19 (0.1)	p<0.01

[1] The data regarding the rate of ACSC represent averages values from 276 of the 278 Portuguese municipalities since two municipalities were excluded due to lack of data on ACSC in the original inpatient database. These municipalities represent 0.72% of the sample.

Figure 5. Rate of ACSC in adopting (with FHU) vs non-adopting municipalities (without FHU) in Portugal, 2000-2015.

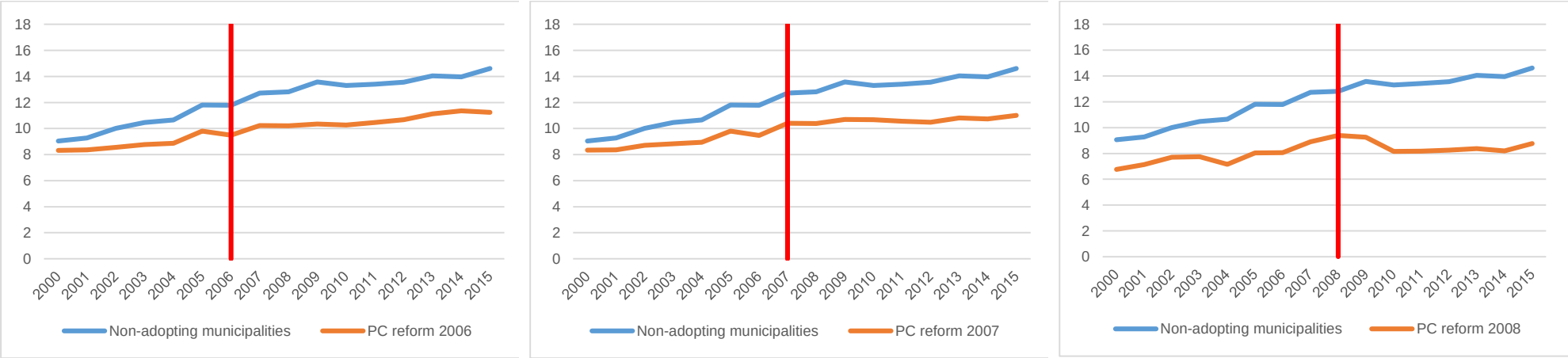


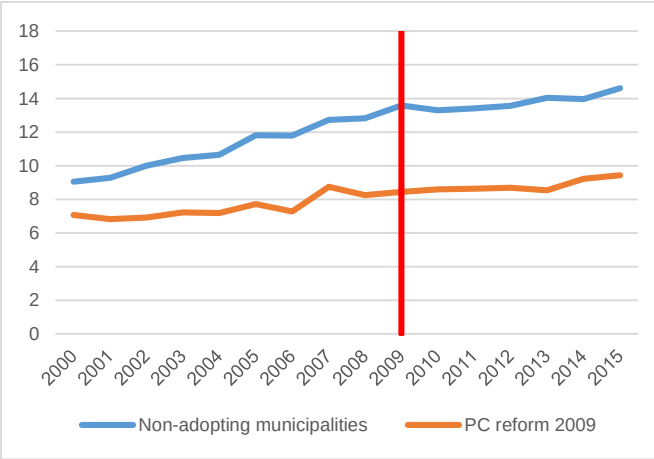
For that reason, we grouped the municipalities according to the year of opening of the first FHU (Table 17). Figure 6 shows us the evolution of the rate of ACSC in the municipalities by the year of adoption of the primary care reform. Overall, after the reform the trend of the rate of ACSC in both adopting and non-adopting municipalities seemed not to diverge at first sight, except for the FHU that opened in 2010 (Figure 17). Nevertheless, these descriptive data cannot tell us much about the effect of the primary care reform because, as explained above, there are other factors affecting the likelihood of adopting the reform that may also affect the evolution of health outcomes.

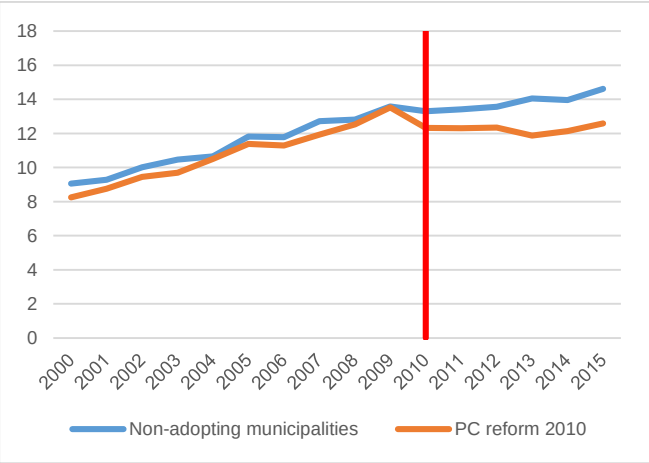
Table 17. Adopting municipalities by year of start of primary care reform

	Year of opening of the first Family Health Unit										
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**Total**
Number of municipalities	28	28	8	14	13	11	5	10	1	8	126

Figure 6. Rate of ACSC in adopting (with FHU) vs non-adopting municipalities (without FHU), by year of opening of first FHU in Portugal, 2000-2015.




18
16
14
12
10
8
6
4
2
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Non-adopting municipalities
PC reform 2009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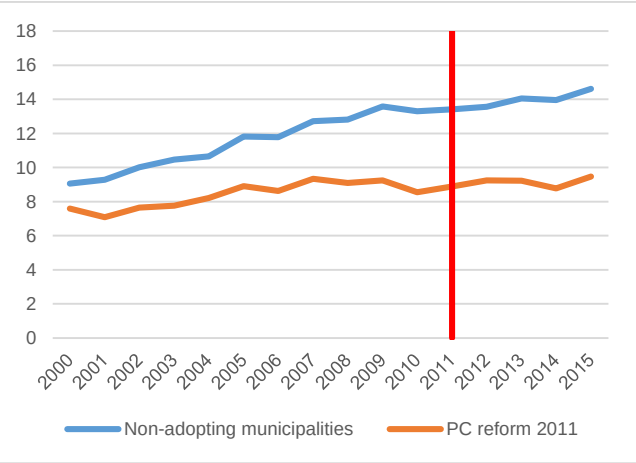
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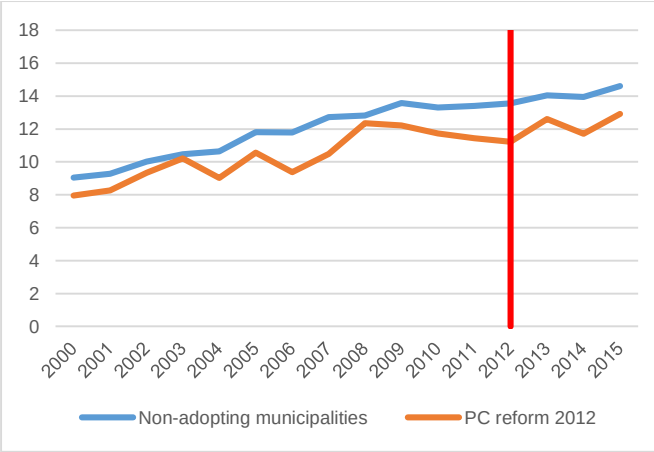
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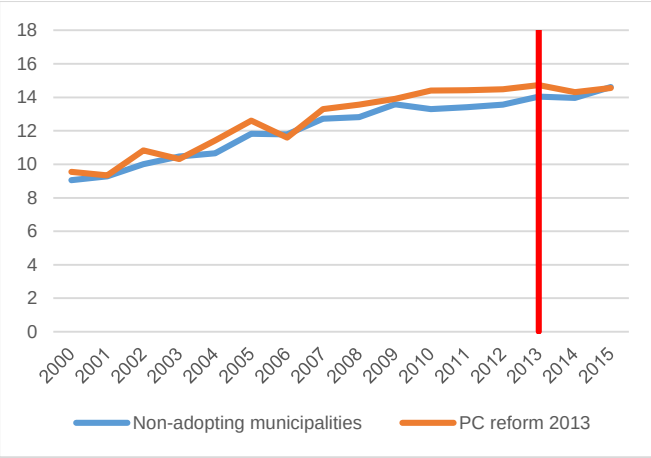
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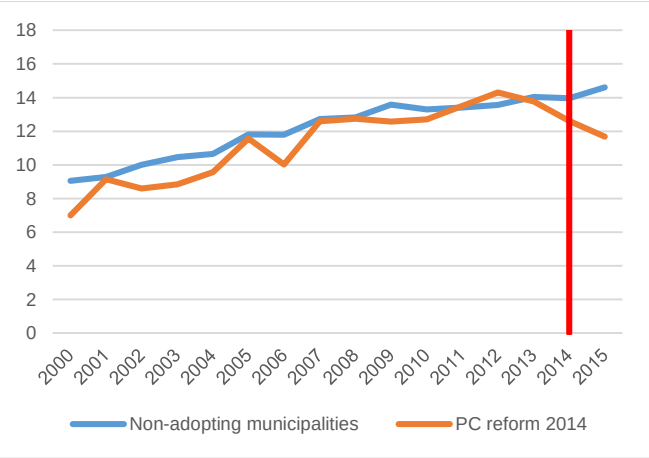
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Incentivized ACSC

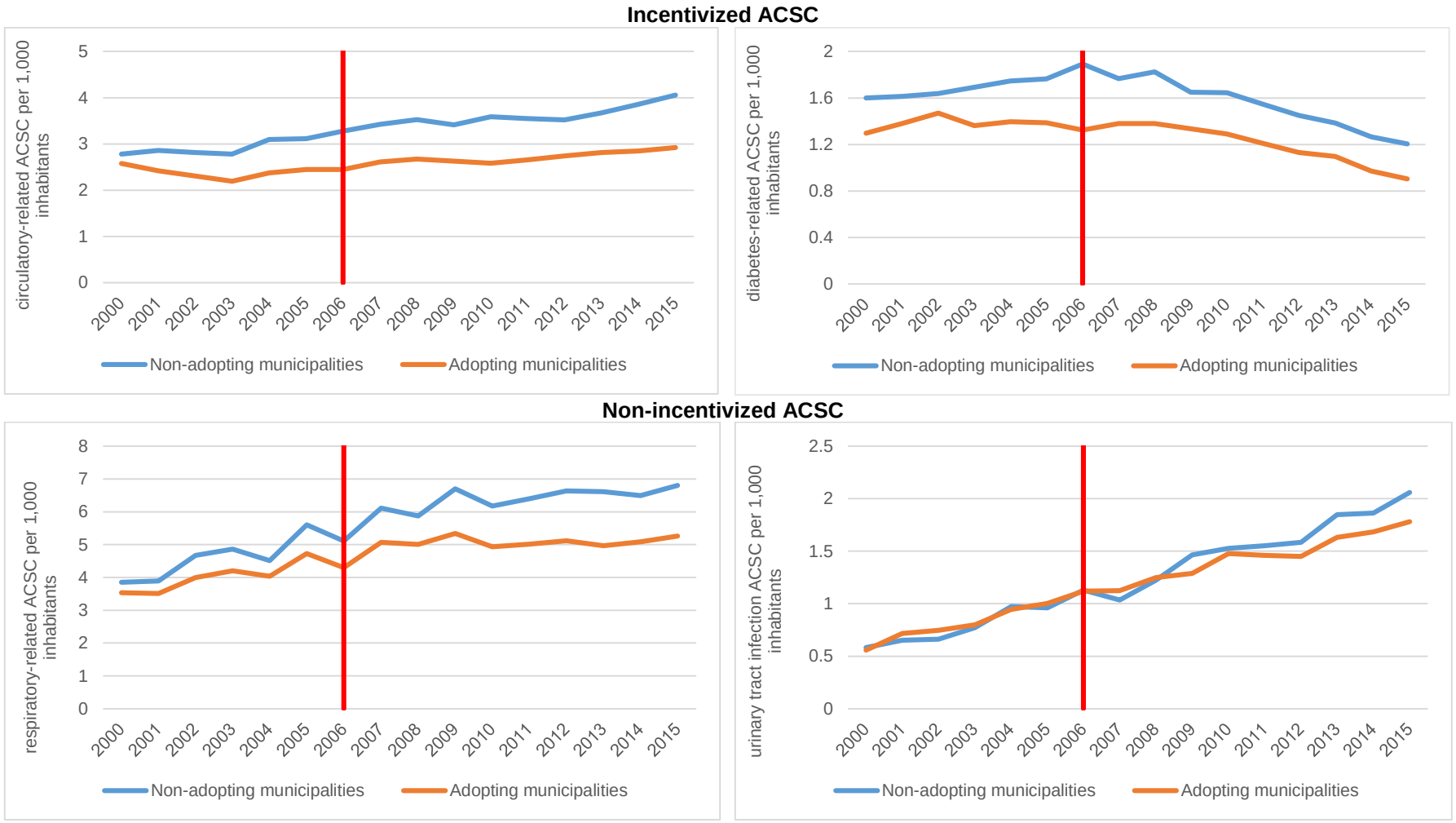
The average rate of circulatory-related ACSC during the study period was 2.99 per 1,000 inhabitants (2.58 in adopting municipalities *vs.* 3.33 in non-adopting municipalities) and the average rate of diabetes-related ACSC was 1.45 per 1,000 inhabitants (1.27 in adopting municipalities *vs.* 1.60 in non-adopting municipalities). Figure 7 shows that the adopting municipalities already presented better health outcomes, as measured by the rate of circulatory and diabetes-related ACSC. Figure 7 also shows that the rate of circulatory-related ACSC continuously increased since 2003, in contrast to the rate of diabetes-related ACSC, which decreased since 2006, in both adopting and non-adopting municipalities.

Non-incentivized ACSC

The average rate of respiratory-related ACSC during the study period was 5.19 per 1,000 inhabitants (4.63 in adopting municipalities *vs.* 5.65 in non-adopting municipalities). The adopting municipalities already had a lower rate of respiratory-related ACSC, but in both groups of municipalities it was continuously increasing between 2000 and 2015 (Figure 7).

Finally, the rate of urinary tract infection ACSC was 1.21 per 1,000 inhabitants (1.18 in adopting municipalities and 1.24 in non-adopting municipalities). The adopting and non-adopting municipalities had very similar rates of urinary tract infection ACSC prior to the primary care reform, slightly higher in the adopting municipalities in some years. After 2006, although this rate was also increasing over the entire period under analysis, we can observe that the slope in the adopting municipalities is less steep (Figure 7).

Figure 7. Rate of incentivized and non-incentivized ACSC in adopting (with FHU) vs non-adopting municipalities (without FHU) in Portugal, 2000-2015.



Difference-in-difference results:

Rate of ACSC per 1,000 inhabitants

Results from the DiD estimates for the rate of ACSC are in Table 18. Results from Equation 1 would wrongly suggest that the primary care reform significantly decreased the yearly rate of ACSC by an average of 0.90 per 1,000 inhabitants (p<0.01) (Eq. 1, Table 3). As mentioned above, the main underlying assumption of the DiD estimate is the parallel trend assumption. However, our results show that the Leads (dummies indicating number of years before the primary care reform) are mostly significant, suggesting the presence of pre-reform differential trends. This implies that the effect of the primary care reform estimated in Equation 1 is partly explained by the existence of non-parallel pre-reform trends in the rate of ACSC. These results confirm empirically the descriptive data shown in Figure 5. Equation 3 (Table 18) shows us that after adjusting for municipality-specific time trends, the DiD estimate is no longer significant (β=-0.24, p=0.21). Finally, even though we did not find a significant overall effect of the primary care reform on the rate of ACSC, we added lags to check if the effects of the reform were not immediate. Results from Equation 4 (Table 18) confirm that there is no significant effect of the primary care reform over time.

Table 18. Difference-in-difference results (Eq.1, Eq. 2, Eq. 3 and Eq. 4) for the rate of ACSC per 1,000 inhabitants (2000-2015)

	Rate of ACSC per 1,000 inhabitants			
	Eq. 1	Eq. 2	Eq. 3	Eq. 4
DiD (PC Reform x After)	-0.8980***	-1.4695***	**-0.2441**	
	(0.2622)	(0.4237)	**(0.1932)**	
Leads				
Before PC reform year 1		-0.8759**		
		(0.4029)		
Before PC reform year 2		-0.7860**		
		(0.3707)		
Before PC reform year 3		-0.7672**		
		(0.3341)		
Before PC reform year 4		-0.6478**		
		(0.2617)		
Before PC reform year 5		-0.4457*		
		(0.2371)		

	Rate of ACSC per 1,000 inhabitants			
	Eq. 1	Eq. 2	Eq. 3	Eq. 4
Lags				
After PC reform year 1				-0.0637
				(0.1754)
After PC reform year 2				-0.0492
				(0.2448)
After PC reform year 3				-0.1846
				(0.3346)
After PC reform year 4				-0.1703
				(0.3959)
After PC reform year 5				-0.0483
				(0.4543)
After PC reform year 6				0.1317
				(0.5231)
After PC reform year 7				0.3651
				(0.6067)
After PC reform year 8				0.5207
				(0.7260)
After PC reform year 9				0.7052
				(0.8529)
After PC reform year 10				0.5097
				(0.9743)
Year fixed-effects	Yes	Yes	**Yes**	Yes
Municipality fixed-effects	Yes	Yes	**Yes**	Yes
Socioeconomic variables	Yes	Yes	**Yes**	Yes
Regional-specific time trends	Yes	Yes		
Municipality-specific time trends (linear)			**Yes**	Yes
Constant	9.9118***	9.7801***	**11.4606****	10.4925**
	(2.2619)	(2.2335)	**(4.9273)**	(4.7278)
Observations	4,416	4,416	**4,416**	4,416
R-squared	0.772	0.773	**0.854**	0.854

*** p<0.01, ** p<0.05, * p<0.1
PC – Primary Care
Notes: Socioeconomic variables include: number of inhabitants, proportion of elderly and purchasing power. Standard errors clustered at municipality level in parentheses.

Incentivized ACSC

Results for the rate of circulatory-related ACSC per 1,000 inhabitants and the rate of diabetes-related ACSC per 1,000 inhabitants are in Table 19. Similarly to the rate of ACSC, results for the rate of circulatory-related ACSC initially suggest that the primary care reform had an effect in the reduction of this indicator (Eq.1c, Table 19). However, in Equation 2c we see that the Leads are highly significant, which means that the data do not comply with the parallel trend assumption. After adjusting for the municipality-specific time trends (Eq. 3c), the DiD estimate is no longer significant, suggesting that the primary care reform did not have a significant impact in the reduction of circulatory-related ACSC (β=-0.03, p=0.64). Additionally, Equation 4c (Table 19) shows no significant effect of the primary care reform over time. Regarding the rate of diabetes-related ACSC, we did not find a statistically significant effect of the primary care reform even in our general DiD estimate, β=0.04, p=0.40 (Eq. 1d, Table 4), clearly suggesting that the primary care reform did not have an impact in the reduction of diabetes-related ACSC.

Table 19. Difference-in-difference results (Eq.1, Eq. 2, Eq. 3 and Eq. 4) for the incentivized ACSC by the pay-for-performance (2000-2015)

Incentivized ACSC by pay-for-performance	circulatory-related ACSC				diabetes-related ACSC
	Eq. 1c	Eq. 2c	Eq. 3c	Eq. 4c	Eq. 1d
DiD (PCReform x After)	-0.3395***	-0.5570***	**-0.0318**		**0.0465**
	(0.0763)	(0.1147)	**(0.0674)**		**(0.0515)**
Leads					
Before PC reform year 1		-0.3732***			
		(0.1028)			
Before PC reform year 2		-0.2916***			
		(0.0924)			
Before PC reform year 3		-0.3014***			
		(0.0832)			
Before PC reform year 4		-0.1813**			
		(0.0772)			
Before PC reform year 5		-0.1742**			
		(0.0848)			

Incentivized ACSC by pay-for-performance	circulatory-related ACSC				diabetes-related ACSC
	Eq. 1c	Eq. 2c	Eq. 3c	Eq. 4c	Eq. 1d
Lags					
After PC reform year 1				0.0256	
				(0.0747)	
After PC reform year 2				0.0542	
				(0.0905)	
After PC reform year 3				-0.0518	
				(0.1215)	
After PC reform year 4				0.0128	
				(0.1376)	
After PC reform year 5				0.0143	
				(0.1694)	
After PC reform year 6				0.1030	
				(0.2033)	
After PC reform year 7				0.2609	
				(0.2482)	
After PC reform year 8				0.2158	
				(0.2831)	
After PC reform year 9				0.2059	
				(0.3466)	
After PC reform year 10				0.2187	
				(0.3900)	
Year fixed-effects	Yes	Yes	**Yes**	Yes	**Yes**
Municipality fixed-effects	Yes	Yes	**Yes**	Yes	**Yes**
Socioeconomic variables	Yes	Yes	**Yes**	Yes	**Yes**
Regional-specific time trends	Yes	Yes			**Yes**
Municipality-specific time trends (linear)			**Yes**	Yes	
Constant	2.5784***	2.5331***	**2.4529**	2.1981	**1.0834****
	(0.7541)	(0.7423)	**(1.7084)**	(1.6196)	**(0.4726)**
Observations	4,416	4,416	**4,416**	4,416	**4,416**
R-squared	0.665	0.667	**0.744**	0.744	**0.548**

*** p<0.01, ** p<0.05, * p<0.1

Notes: Socioeconomic variables include: number of inhabitants, proportion of elderly and purchasing power. Standard errors clustered at municipality level in parentheses.

Non-incentivized ACSC

Results for the rate of respiratory-related ACSC per 1,000 inhabitants and the rate of urinary tract infection ACSC are in Table 20. Results from Equation 2r (Table 20), show some significant Leads and a progressive increase in the coefficients over time. Even though the Leads are not as highly significant as in the previous cases, still we cannot confidently assume that our data follow the parallel trends assumption, and therefore we included municipality-specific time trends. Results from Equation 3r (Table 20) show that the DiD estimate is no longer significant, suggesting that the primary care reform did not have a statistically significant impact in the reduction of the rate of respiratory-related ACSC (β=-0.13 p=0.26). This effect was also not visible over time (Eq. 4r, Table 20).

The primary care reform significantly decreased the yearly rate of urinary tract infection ACSC by an average of 0.12 per 1,000 inhabitants (Eq. 1u, Table 20). Since the pre-existing trends of these indicators follow the parallel trends assumption: i.e., the coefficients of the Leads in Equation 2u are not statistically significant, so we can be assured that the parallel trend assumption is not violated. These results can be visually confirmed in Figure 7. Moreover, even if we added the municipality-specific time trends to our model (Eq. 3u, Table 20), the DiD estimate remains unchanged (β=-0.12 $p<0.05$). The results from Equation 4u (Table 20) suggest that the reform decreased urinary tract infections from 3 years after the implementation and thereafter.

Table 20. Difference-in-difference results (Eq.1, Eq. 2, Eq. 3 and Eq. 4) for the non-incentivized ACSC by the pay-for-performance (2000-2015)

Non-incentivized ACSC by pay-for-performance	respiratory-related ACSC				urinary-related ACSC			
	Eq. 1r	Eq. 2r	Eq. 3r	Eq. 4r	Eq. 1u	Eq. 2u	Eq. 3u	Eq. 4u
DiD (PC Reform x After)	-0.4496***	-0.7478***	**-0.1322**		**-0.1206****	-0.1050	-0.1172**	
	(0.1612)	(0.2515)	**(0.1181)**		**(0.0608)**	(0.0958)	(0.0579)	
Leads								
Before PC reform year 1		-0.4229*				-0.0073		
		(0.2353)				(0.0874)		
Before PC reform year 2		-0.4086*				0.0288		
		(0.2128)				(0.0879)		
Before PC reform year 3		-0.4107**				0.0372		
		(0.1947)				(0.0895)		
Before PC reform year 4		-0.3990***				0.0334		
		(0.1497)				(0.0613)		
Before PC reform year 5		-0.2097				0.0156		
		(0.1333)				(0.0485)		
Lags								
After PC reform year 1				-0.0498				**-0.0511**
				(0.1132)				**(0.0550)**
After PC reform year 2				-0.0361				**-0.0694**
				(0.1523)				**(0.0547)**
After PC reform year 3				0.0098				**-0.1367****
				(0.2049)				**(0.0683)**
After PC reform year 4				-0.0463				**-0.1371***
				(0.2407)				**(0.0804)**
After PC reform year 5				0.1000				**-0.1916****
				(0.2764)				**(0.0902)**

Non-incentivized ACSC by pay-for-performance	respiratory-related ACSC				urinary-related ACSC			
	Eq. 1r	Eq. 2r	Eq. 3r	Eq. 4r	Eq. 1u	Eq. 2u	Eq. 3u	Eq. 4u
After PC reform year 6				0.2239				**-0.2101***
				(0.3231)				**(0.1171)**
After PC reform year 7				0.2972				**-0.2660****
				(0.3771)				**(0.1239)**
After PC reform year 8				0.3553				**-0.1906**
				(0.4325)				**(0.1637)**
After PC reform year 9				0.5250				**-0.1188**
				(0.5083)				**(0.1751)**
After PC reform year 10				0.4501				**-0.1978**
				(0.5896)				**(0.2154)**
Year fixed-effects	Yes	Yes	**Yes**	Yes	**Yes**	Yes	Yes	**Yes**
Municipality fixed-effects	Yes	Yes	**Yes**	Yes	**Yes**	Yes	Yes	**Yes**
Socioeconomic variables	Yes	Yes	**Yes**	Yes	**Yes**	Yes	Yes	**Yes**
Regional-specific time trends	Yes	Yes			**Yes**	Yes		**Yes**
Municipality-specific time trends (linear)			**Yes**	Yes			Yes	
Constant	4.6152***	4.5448***	**6.3792*** **	6.0231***	**1.5590*** **	1.5652***	1.2258	**1.5147*** **
	(1.1911)	(1.1794)	**(2.4361)**	(2.2951)	**(0.5462)**	(0.5480)	(1.0407)	**(0.5566)**
Observations	4,416	4,416	**4,416**	4,416	**4,416**	4,416	4,416	**4,416**
R-squared	0.712	0.713	**0.798**	0.798	**0.655**	0.655	0.747	**0.656**

*** p<0.01, ** p<0.05, * p<0.1.
PC – Primary Care
Notes: Socioeconomic variables include: number of inhabitants, proportion of elderly and purchasing power. Standard errors clustered at municipality level in parentheses. Equation 4 for the rate of urinary tract infection ACSC is not adjusted for the municipality-specific time trends but for regional-specific time trends since the data follow the parallel trend assumption

Sensitivity analysis:

We performed several sensitivity analyses on our results. First, we converted the DiD estimate $\beta_1(PC\ Reform_m\ x\ After_{mt})$ into a continuous variable to estimate the degree of implementation of the primary care reform, since the reform was not uniform across adopting municipalities. In this analysis we re-estimated Equation 3 and measured the intensity of the implementation of the primary care reform as the number of FHUs functioning per 10,000 inhabitants: $\beta_1(FHP\ rate_{mt}\ )$. Therefore, the intensity of the implementation of the reform depended on both the number of FHUs operative per municipality and the number of inhabitants in that municipality, who are the potential users. Results were similar to the original model, and even though the intensity of the primary care reform was associated with a lower rate of ACSC, the estimate was not statistically significant (β=-0.50, p=0.21). We repeated this regression for all dependent variables and all results (available from the authors upon request) remained similar to those in the original model: we did not find a statistically significant effect of the intensity of the primary care reform in the rate of circulatory-related ACSC, diabetes-related ACSC, or respiratory-related ACSC. We did find a negative and significant effect for the rate of urinary tract infection ACSC. Specifically, establishing one more FHU per 10,000 inhabitants significantly reduced the rate of urinary tract infection ACSC by 0.28 per 1,000 inhabitants (p<0.05).

Second, we converted our DiD estimate into two estimates according to the type of FHU: FHU model A and FHU model B: $\beta_1(PC\ Reform_{\ m}\ x\ AfterA_{mt})$ + $\beta_2(PC\ Reform_m\ x\ AfterB_{mt})$. Thus, we re-estimated Equation 3 with $AfterA_{mt} = 1$ if the municipality had at least one FHU-A opened at year t, and no FHU-B; and $AfterB_{mt} = 1$ if the municipality had at least one FHU-B opened at year t. As mentioned previously, it is necessary to be an FHU-A first, before converting into an FHU-B. FHUs model B are more demanding in terms of the goals established in the incentivized indicators, but are also the ones that are entitled to individual financial incentives. We obtained results consistent with our original model. We found a negative and non-significant association for both FHU model A and model B on the rate of ACSC, the rate of circulatory-related ACSC, and the rate of respiratory-related ACSC; and a positive and non-significant association for the rate of diabetes-related ACSC. For the rate of urinary tract infection ACSC, we found a negative and statistically significant effect of the FHU model A and FHU model B of β=-0.11, p<0.1 and β=-0.25, p<0.01, respectively. These results suggest that the negative effect found in this rate is greater in FHU model B.

Third, we performed the same analysis by grouping the 12 ACSC into two groups and re-estimated Equation 3 where the y_{mt} is the rate of all incentivized ACSC (i.e., "diabetes short-term complications" + "diabetes long-term complications" + "uncontrolled diabetes" + "lower-extremity amputation diabetes" + "hypertension" + "heart failure" + "angina without procedure") and the rate of all non-incentivized ACSC (i.e., "COPD or asthma in older adults" + "asthma in younger adults" + "bacterial pneumonia" + "urinary tract infection" + "dehydration"). We did not find a statistically significant effect of the primary care reform on the incentivized ACSC (β=-0.02, p=0.83) nor in the non-incentivized ACSC (β=-0.23, p=0.13). Finally, we, performed the same analysis for each of the 12 ACSC separately, as long as we had enough cases in each category (i.e., except for: "hypertension", "dehydration", "asthma in younger adults", "diabetes short-term complications", "uncontrolled diabetes", and "lower-extremity amputation diabetes"). Again, we did not find a statistically significant effect of the primary care reform on any of the individualized ACSC.

Discussion

Key findings:

The primary care reform in Portugal was initiated in municipalities with better health outcomes, a larger and younger population, and greater purchasing power. Results suggest that the primary care reform did not significantly reduce the rate of ACSC or the rate of disease-specific ACSC related to health conditions targeted in the pay-for-performance (diabetes-related ACSC and circulatory-related ACSC).

Interpretation:

The Portuguese primary care reform was an ambitious effort aimed at improving the quality of primary care, primarily through the creation of small multi-disciplinary FHUs, with functional and technical autonomy and paid by capitation and according to performance, and in which each citizen is assigned to a "family physician". Between 2006 and 2015 448 FHU were created in 126 municipalities. However, the opening of FHUs was left to the will of voluntary groups of healthcare professionals, which led to the opening of FHUs in richer, younger, and healthier municipalities. This was not a surprise, since more health professionals are expected to live in urban and younger areas with better socioeconomic conditions. However, the voluntary and progressive nature of the reform offered an interesting natural experiment to evaluate its impact.

To date, no evaluation of the primary care reform has been undertaken in terms of health outcomes, and thus, in this study we analysed the Portuguese primary care reform on population health outcomes measured by the rate of ACSC over a long period of time (2000-2015). ACSC have been largely studied as an indirect measure of access to timely and effective primary care.[59,74] Specifically, studies show that an adequate supply of primary care physicians and a long-term relationship between the primary care physician and the patients reduces the rate of ACSC.[42]

We did not find a statistically significant effect of the Portuguese primary care reform on the rate of ACSC between 2000 and 2015 (β=-0.24, p=0.21). Additionally, the national crude rate of ACSC increased from 8.65 per 1,000 inhabitants to 13.06 per 1,000 inhabitants between 2000 and 2015. These results suggest that other important characteristics, other than the primary care supply and quality in primary care, are determinant for the rate of ACSC. We may hypothesize that population ageing,[1] the increase in chronic conditions, and the rise of multi-morbidity[188] are responsible for the increase in ACSC.

We found a statistically significant effect of the primary care reform in only one non-incentivized area of the pay-for-performance, the rate of urinary tract infection ACSC. Although the overall rate of urinary tract infection increased between 2000 and 2015, the slope was less pronounced in the adopting municipalities after the reform. The rate of urinary tract infection ACSC is one of the few acute conditions classified as ACSC, and we may assume that patients assigned to FHUs had faster and easier access to primary care, which in this case has proven to be essential to avoid hospitalization.

In this study we also assessed the impact of the primary care reform on the disease-specific ACSC related to the incentivized areas in the pay-for-performance. The rationale for this analysis is that if the conditions included in the pay-for-performance are ambulatory care sensitive, and the scheme is effective in the desired quality improvement, it should also lead to a reduction in these avoidable hospital admissions.[25] However, we did not find a statistically significant effect of the primary care reform on the rate of disease-specific ACSC targeted in the pay-for-performance.

Our results differ from those of Harrison et al. (2014), who found that the introduction of the Quality and Outcomes Framework in the United Kingdom was associated with a moderate and sustained decrease in incentivized ACSC, compared with those that were not directly incentivized by the pay-for-performance scheme.[25] Nevertheless, as the authors conclude, the improvements that occurred under the pay-for-performance scheme were greater for indicators related to measurements (e.g., recording of blood

pressure) rather than for indicators related with intermediate outcomes (e.g., blood pressure control), which would be more likely to have an immediate impact on the ACSC. Therefore, they argue that this modest improvement on intermediate outcomes may have not been sufficient for them to attribute the observed effect on ACSC solely to the Quality and Outcomes Framework scheme.[25] For example, Mendelson et al. (2017) claim that pay-for-performance schemes are usually implemented along with other interventions, such as public reporting, audit and feedback, and electronic decision-support tools, which can also have a considerable influence in quality improvement.[46] Other studies also showed a positive and significant association with pay-for-performance and reduced avoidable hospitalizations,[175,176] but these studies do not capture the overall trend in ACSC before the introduction of the pay-for-performance. In fact, in a systematic review, Houle et al. (2012) show that results from uncontrolled studies suggest that pay-for-performance improves quality of care, but that the majority of studies with more sophisticated methodologies such as randomized trials and interrupted time series failed to confirm these findings, and did not find any improvements in clinical outcomes after pay-for-performance implementation.[171]

Regarding our findings, on one hand we may hypothesize that the pay-for-performance scheme, even though it was previously associated with improvement in processes of care (e.g., “blood pressure checks” and “diabetes checks”), did not have an impact in the reduction of disease-specific ACSC because it was not directly designed to target the avoidable hospitalizations. The performance indicators related to intermediate outcomes, and thus more likely to have had an impact on ACSC, such as “Proportion of hypertensive patients with less than 65 years of age with a registry of blood pressure < 150/90” and “Proportion of diabetic patients with at last one glycosylated haemoglobin (HbA1c) test registry <= 8,0%”, were introduced only in 2014 (Table A2 and A3 in Appendix II). On the other hand we may hypothesize that the pay-for-performance simply did not achieve the expected results. There is a large body of literature, including two recent systematic reviews, showing that pay-for-performance is not consistently effective in improving quality of care and that there is still an uncertainty in the literature on the effect of pay-for-performance on patient outcomes.[46,171] This uncertainty may be due in part to the differences in the pay-for-performance design and the context in which they are implemented.[25] Our results complement the previous literature, and reinforce that pay-for-performance in primary care in Portugal has not been consistently effective in improving patient health outcomes as measured by the rate of disease-specific ACSC.

Strengths and Limitations:

One of the main strengths of our study is that the progressive implementation of the reform provides us with a "natural experiment" that allows us to compare "treated" (implementing) and "non-treated" (non-implementing municipalities) within the same country (Portugal), a comparison that is not possible in the United Kingdom since the Quality and Outcomes Framework was implemented nationally. Another strength of our study is the long data series (16 years), which allowed us to estimate the long-term effect on health outcomes, and allowed us to estimate trends more accurately.

Regarding the limitations of our study, first, part of the effect of the primary care reform might be captured by the municipality-specific trends that we added to our model, since their inclusion reduces the degree of freedom and might potentially affect the significance of our results.[186,187] Nevertheless, results for the rate of urinary tract infection ACSC show that even after adjusting for the municipality-specific trends, the effect of the primary care reform did not change. This gives us confidence that even in our most conservative specification (with municipality-specific trends) the effect of the primary care reform is still captured.

Second, we can suspect that some changes of the primary care reform, other than the creation of FHUs and the introduction of pay-for-performance, may have affected the primary care practices in non-adopting municipalities (i.e., the PHCU). For example, during the primary care reform the PHCU were required to report virtually the same performance indicators, even though they were not eligible for any incentives.[179] These changes in data recording may have led to an improvement in clinical practice and thus to an overall performance of these primary care practices. Nevertheless, what we aimed to capture in this study are the unique features of the FHU: the shift from the primary care provision in single-handed practices into multidisciplinary teams with technical and functional autonomy and partly paid by pay-for-performance.

Finally, our study focused on only some of the conditions included in the pay-for-performance scheme, those that are ambulatory care sensitive (based on the set of guidelines for the adult population as defined by the Agency for Healthcare Research and Quality)[57] and that should lead to a reduction in hospital admissions and to an overall healthier status of the patient due to better disease management. Other performance indicators incentivized under the pay-for-performance scheme, namely related to cancer screening, vaccination, and child and maternal heath are not included in this analysis. We therefore cannot comment on the effect of pay-for-performance on health outcomes related to those conditions.

Conclusion

The Portuguese primary care reform did not significantly reduce the rate of ACSC or the rate of disease-specific ACSC related to health conditions targeted in the pay-for-performance. This finding, in line with the recent literature on pay-for-performance, questions the capacity of this payment mechanism to achieve better health outcomes, and invites a more careful and evidence-based action toward its wider diffusion.

Research highlights

- A primary care reform including a pay-for-performance scheme was initiated in Portugal in 2006.
- We evaluated the impact of this reform using a difference-in-difference analysis.
- We found no significant impact on the rate of ACSC.
- This finding also held for conditions specifically incentivized by the pay-for-performance scheme.
- These results question the capacity of pay-for-performance to improve patient health outcomes.

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Authors' contributions

KD contributed to study conceptualisation and design, data acquisition and analysis and interpretation and drafted the manuscript. JP contributed to study conceptualisation and manuscript revision. MSA contributed to study conceptualisation and design, data analysis and interpretation and manuscript revision. All authors read and approved the final manuscript.

5. Discussion

The importance of primary care has long been recognized globally. As a result, European countries, including Portugal, have been investing in primary care and implementing supportive governmental health policies to strengthen this level of care. Despite the literature on the beneficial effects of an effective and high-quality primary care system on population health, there is still a gap in our knowledge regarding the contribution of its effectiveness on specific outcomes. Specifically, little is known about the effects of the impact of the recent Great Recession in access to primary care, about the effectiveness of a primary care system on the reduction of emergency department visits, and about the impact of pay-for-performance in primary care on patient health outcomes. Additionally, no study on the effects of the Portuguese primary care reform on health outcomes and secondary care use has been undertaken to date. Thus, this dissertation has two main objectives (i) evaluate changes and inequalities in access to primary care in Europe and in Portugal and (ii) evaluate the impact of the Portuguese primary care reform on secondary care use. Specifically, four main associations are explored. First, a focus on the impact of the Great Recession on self-reported access to primary care; second, the role of individual and contextual socioeconomic characteristics on access and continuity of care in primary care in Portugal; third, the effect of the Portuguese primary care reform on emergency department visits and their potential savings; and finally, the impact of the Portuguese primary care reform on the rate of ACSC. The main results are summarized and discussed below.

5.1. Key Findings

5.1.1. Changes and inequalities in access to primary care in Europe and in Portugal

The effects of the Great Recession on access to health, as measured by the self-reported unmet medical needs, have been documented in several studies.[96–98,114–116] These studies show that unmet medical needs increased significantly across Europe during the Great Recession, especially in the most vulnerable populations, but did not investigate where these needs were unmet.[96–98,114–116] Also, no study has investigated access to primary care during this period, even though it is the main avenue to health care for most European citizens. Therefore, the first paper aimed at analyzing the

change in self-reported access to primary care before and during the Great Recession. Additionally, it examined if some countries' health system characteristics influenced access to primary care during this period, and if low-socioeconomic status person's access has been more affected than others' during this period. It was hypothesized that access to primary care would worsen during the Great Recession, especially for the more disadvantaged groups of population, similarly to the results found in previous studies that measured access to health through unmet medical needs. This hypothesis was not confirmed. Results showed that there was an overall improvement in access to primary care in Europe during the Great Recession and that even though there was poorer access among low-socioeconomic status persons, these inequalities did not worsen during this period.

These findings lead to important conclusions. First, during the Great Recession, in the majority of European countries there was an impulse toward outpatient care through the substitution of secondary care by primary care, an increased centralization of hospitals with improved coordination in primary care, and an overall investment in primary care [22,23] that might have led to an overall improvement in access to primary care. Also, results show that this improvement was greater for people living in countries where this investment was higher, suggesting that countries with higher investment in health and health care resources were better positioned to face the detrimental effect of the crisis to ensure access to primary care. This highlights the importance of supportive primary care policies, especially during economic recessions. For example, in Portugal, a primary care reform had already been underway since 2006, when severe austerity measures had to be adopted. Nevertheless, the strengthening of primary care was encouraged by boosting the number of FHUs.[189] It was ensured that despite the increase in user charges (co-payments) at all levels of care, this rise was proportionally lower for primary care, and the fees remained relatively low. Also, other incentives were implemented to encourage patients to go first to primary care, such as the exemption of user charges in emergency care from episodes that resulted from referral by a general practitioner.[117]

Second, people with low socioeconomic status, i.e. with lower education, lower ability to make ends meet, and those with material deprivation, experienced poorer access to primary care, suggesting significant socioeconomic inequalities in favor of high-socioeconomic status persons, after controlling for need differences. Earlier studies reported no evidence of income-related inequality in the utilization of primary care services measured by the probability of visiting a general practitioner and by the

conditional number of visits in the European Union[118] and OECD[119] countries. Some authors even report a pro-poor distribution in some countries.[119,120] While those studies focused on utilization of primary care services, these results suggest that accessing primary care is a considerable burden for people with low-socioeconomic status, and that they may live in socioeconomic disadvantaged areas where access to primary care may be influenced by contextual characteristics such as the availability (or not) of transportation systems, by the distance to primary care facilities, and by a shortage of primary care physicians.[39]

Furthermore, it was hypothesized that access to primary care would worsen during the Great Recession especially for the more disadvantaged groups of the population. The results showed that the poor access among low-socioeconomic status people was stable over this period, suggesting that the most vulnerable populations were not negatively affected in relation to the better-off, during the economic crisis, and that some policy measures were in place to provide some social and financial protection to the poorer people. For example, in Portugal exemptions to user charges increased considerably, with the purpose of protecting the lower-income people and other vulnerable population groups.[117] Also, a recent study points to a reduction of socioeconomic inequalities in the proportion of people lacking a designated general practitioner between 2009 and 2014, which may have had an impact on the access to primary care among low-socioeconomic status persons.[190] Nevertheless, the first paper draws attention to the persistent socioeconomic inequalities in access to primary care in Europe, and highlights the need for more inequality-targeted policy interventions in this level of care.

Having observed these socioeconomic inequalities in Europe, a more detailed analysis of such inequalities was performed for Portugal. The case of Portugal is of great interest because the primary care system is characterized by relatively low-co-payment rates and universal coverage, in which general practitioners act as strong gatekeepers. However, it is also one of the European Union countries with the highest inequalities in income distribution and risk of poverty,[128] and recent evidence shows considerable socioeconomic health inequalities[31] and strong associations between material deprivation and mortality.[129,191] Hence, even though the NHS guarantees that no one is excluded from access to care, the strong socioeconomic inequalities may hinder this access through other mechanisms. This is why we decided to investigate the socioeconomic inequalities in access to primary care and continuity of care as measured by the rate of ACSC, which may reflect inequalities in early and preventive care, and be

a possible explanation for the subsequent considerable socioeconomic inequalities in health.

Therefore, the second paper aimed at measuring such inequalities and their evolution over a protracted period of time (2000-2014), and their financial burden on the Portuguese NHS. It was hypothesized that there would be a socioeconomic patterning in ACSC, which possibly reflects the socioeconomic inequalities in access to primary care and continuity of care in Portugal. The findings confirmed the existence of significant socioeconomic inequalities in ACSC, showing that in the most disadvantaged municipalities, i.e., those with the highest levels of illiteracy and lowest levels of purchasing power, the rates of ACSC were the highest, after adjusting for the proportion of elderly, sex, disease-specific mortality rate, population density, and primary care supply. These inequalities may be driven by individual and contextual factors. That is, people living in more deprived areas are more likely to have lower literacy levels and to experience material and financial deprivation. Therefore, they are less likely to adopt self-management behaviors since they have a poorer understanding of how the disease affects their life, of how to cope with the symptoms, and of how to maintain good control throughout the course of the disease;[54] and they are more likely to experience delay in care due to transportation costs and lack of knowledge of the health care system.[127]. Also, in lower-income areas there may be lower cultural and social support for early care and prevention, and the access to primary care may be affected by the distance to these facilities and by the availability of transportation systems. These inequalities impose a substantial financial burden on the Portuguese NHS, estimated at more than 15 million euros per year.

Results from this study also showed that there has been a widening of socioeconomic inequalities in the rate of ACSC over the 2000-2014 period. It is known that relative socioeconomic inequalities in health in Europe have not only persisted over the last three decades, but have also widened, according to recent measures.[123,139] Our findings are consistent with these, suggesting that increasing inequalities in ACSC, which reflect inequalities in early and preventive care, are a possible explanation for these widening disparities in health. Overall, these findings reflect the current lack of a nationally-oriented research strategy on health inequalities and point to the need to implement effective public policies to reduce social inequalities. This weakness of governance system in interventions to reduce inequalities is common in many European countries,[192] and shows that despite universal coverage and low co-payments, the Portuguese NHS may be failing to avoid inequalities in access to care.

5.1.2. Impact of the Portuguese primary care reform on secondary care use

The previous section provided evidence that inequalities in access and continuity of care in primary care may exist despite universal coverage and relatively low co-payments. This finding questions the current organization and financing of primary care in Portugal, which has undergone substantial reform since 2006. Hence, some of the main goals of the primary care reform, such as improving access and continuity of care and ultimately improving efficiency,[2718] may not have been achieved yet.

The most significant feature of this reform was the creation of a new organizational model of primary care provision: FHUs, which consisted of small voluntarily constituted multidisciplinary teams, which have functional autonomy and are partly financed through capitation and pay-for-performance. Some available data suggest that these units are performing better than the PHCU in the quality of care delivered, as measured by the improvement in processes of care (e.g. “blood pressure checks” and “diabetes checks”)[28]. Nevertheless, no study has been made to date on the impact of the primary care reform on secondary care use and health outcomes. Therefore, the third and fourth papers aimed at measuring the impact of the primary care reform (i.e. the creation of FHUs) on emergency department visits and ACSC, respectively.

Regarding emergency department visits, it was not possible to evaluate its evolution over time and consequently to measure the “true” impact of the primary care reform on this indicator, since data were available only for the years 2013 to 2015. Instead, the probability of having an emergency department visit, based on the patient assignment in each of the organizational models of primary care provision (i.e. FHU and PHCU), was estimated. It was hypothesized that people assigned to the new primary care provision model (FHU) would have fewer emergency department visits, due to the supposed increase in access to primary care. This was confirmed, and a significantly lower utilization of emergency departments was observed in people assigned to FHU model A and to FHU model B, in comparison to those assigned to the PHCU, after adjusting for the sociodemographic characteristics of the patient, severity of the emergency department visit, pre-existing health conditions, and the patient´s probability of being assigned to each of the primary care provision models.

The lower emergency department utilization may be related to the underlying characteristics of the FHU such as better quality in care provided due to the multidisciplinary nature of the practice, quicker and better access due to its longer opening hours, and better continuity of care, which is in line with previous literature on the effectiveness of primary care on the reduction of emergency department

visits.[79,80,152,165,81–88] Additionally, patients assigned to FHU model B had the lowest number of emergency department visits among the three primary care provision models. As mentioned previously, FHUs of model B are more demanding in terms of the goals established in the incentivized indicators, but are also the ones that are entitled to individual financial incentives. Based on this probability, potential savings were estimated if people from PHCU were assigned to FHU model B. These savings (16 million euros per year) aim to reflect hypothetical savings from this transition and do not take into account the investment needed to transform the PHCU into a model B type FHU.

As mentioned above, in this study an additional adjustment based on the patient´s probability of being assigned to each of the primary care provision models, was made. The reason for this is that since 2006, the progressive expansion of FHUs across Portugal was based on voluntary decisions and was unrelated to any specific geographic criterion or population needs assessment, so the population started to be covered or not by an FHU depending on whether a new FHU was created in their geographical area of residence. Consequently, the demographic and socioeconomic profile of people assigned to each of the models are different, and so are their underlying differences in terms of health outcomes. In fact, FHUs were established in less disadvantaged geographic regions, i.e. in municipalities with lower proportion of elderly, lower rates of mortality by specific diseases, a higher proportion of people with tertiary education, and those with greater purchasing power, in comparison to the population served by the PHCU. This current organization of primary care raises major concerns, since FHUs may have unintentionally caused asymmetries in access to primary care, and enhanced asymmetries in the quality of services provided, inducing greater inequalities in the provision of primary care.

In order to delve further into this issue, the fourth paper sought to determine if the Portuguese primary care reform (i.e. creation of FHUs) affected population health outcomes and secondary care use, as measured by the rate of ACSC. Specifically, by exploiting the fact that FHUs were created over different municipalities and years, their impact on the rate of ACSC over the 2000-2015 period was assessed. As mentioned above, ACSC represent health conditions the exacerbation of which leads to a hospitalization episode that is potentially avoidable and therefore have been largely used as an indirect measure of an effective primary care system, and the most commonly used.[56–59] Specifically, studies show that an adequate supply of primary care physicians and a long-term relationship between the primary care physician and the

patients reduces the rate of ACSC.[42] Additionally, in the fourth paper the impact of the primary care reform on the disease-specific subset of ACSC related to the incentivized indicators under the pay-for-performance scheme was explored, in order to contribute to the international literature on the effectiveness of this type of payment on health outcomes. A similar analysis has been performed by other authors, with mixed results.[25,175–177] The rationale for this analysis is that if the conditions included in the pay-for-performance are ambulatory care sensitive, and the scheme is effective in the quality improvement, it should also lead to a reduction in these avoidable hospital admissions.[25] The results showed that the primary care reform did not significantly reduce the rate of ACSC or the rate of disease specific ACSC related to health conditions targeted in the pay-for-performance scheme (circulatory-related ACSC and diabetes-related ACSC), after adjusting for municipality level socioeconomic characteristics, year and municipality fixed effects, and municipality-specific time trends. Additionally, the national crude rate of ACSC increased from 8.65 per 1,000 inhabitants to 13.06 per 1,000 inhabitants between 2000 and 2015. These results suggest that other important characteristics beyond the (presumed) better access and better quality in care provided in FHUs are determinant for the rate of ACSC. We may suspect that population ageing, the increase in chronic conditions and the rise of multimorbidity are responsible for the increase in ACSC.

Regarding the absence of significant effects of the primary care reform on the rate of disease-specific ACSC, it is hypothesized that the pay-for-performance scheme, even though it was previously associated with improvement in processes of care (e.g. “blood pressure checks” and “diabetes checks”),[28] did not have an impact on the reduction of disease-specific ACSC simply because it was not directly designed to target the avoidable hospitalizations. The performance indicators related to intermediate outcomes (and thus more likely to have had an impact on ACSC, such as "Proportion of hypertensive patients with less than 65 years of age with a registry of blood pressure < 150/90” and "Proportion of diabetic patients with at least one glycosylated haemoglobin (HbA1c) test registry <= 8.0%”) were introduced only in 2014.

Nevertheless, it is important to note that a large body of literature, including two systematic reviews, show that even though there is still uncertainty in the literature on the effect of pay-for-performance on patient outcomes, the few studies with more sophisticated methodologies such as randomized trials and interrupted time series did not find a statistically significant effect of pay-for-performance in primary care on quality of care and patient health outcomes.[46,171] The results from this study complement the

previous literature, and reinforce the belief that pay-for-performance has not been consistently effective in improving patient outcomes.

Mendelson et al. (2017) provide some explanations on why this might happen. First, the authors argue that usually pay-for-performance schemes are implemented along with other interventions, such as public reporting, audit and feedback, and electronic decision-support tools, which also have a great influence on quality improvement, and thus the incremental benefit of pay-for-performance can be difficult to demonstrate. Second, they argue that pay-for-performance schemes have not been clearly implemented using the principles of behavioral economics, in which factors such as payment size, timing, and frequency are believed to have important influences on individual behavior. However, no consistent data are available in order to infer which the best incentive structure is. For example, there is evidence that even a small incentive (worth less than 5% of annual income) had a positive effect in some settings, while much larger incentives were ineffective in other settings. Third, the lack of evidence on patient outcomes may also be due to the deficiencies in the methods that have been used to measure these effects and the long time that it takes for process-of-care improvements to translate into patient outcome improvements.[46]

Finally, this paper shows that the FHUs were adopted in municipalities that already presented lower rates of ACSC, reinforcing the belief that the voluntary establishment of the FHUs led to the opening of these units in municipalities with better health outcomes. Even though this was not evident in our findings, the concerns about possible inequalities in access and in the quality of services provided in primary care remain, and may be evident in other health indicators not included in this study. The full coverage of the Portuguese population by a general practitioner is the first crucial step in order to reduce the inequalities in access to primary care.

5.2. Strengths and limitations

The strengths and limitations of this dissertation should be acknowledged, reinforcing or adding to those enumerated in each of the four papers. First, an important limitation is the data availability in the first and third papers, which did not allow for a more detailed analysis, which would have allowed measuring causal relationships. In the first paper it was not possible to measure the yearly evolution of the difficulty of access to primary care before and during the entire period of the Great Recession, since only two cross sectional databases are available that focus on this issue. In addition, data were repeated cross-sectional rather than longitudinal, which would have allowed following the same individuals over time, if their access had reduced during the Great Recession, regardless of other personal circumstances. In the third paper a longitudinal analysis over a longer period on the evolution of emergency department visits of the patients assigned to each of the primary care provision models would be desirable, since it is possible that the lowest utilization pattern of emergency department by persons assigned to FHU was already present before the primary care reform. This bias was to some extent overcome by adjusting for the probability of being assigned to each of the primary care provision models, but this adjustment may have been insufficient. Consequently, it is not possible to infer a causal effect of the change in the primary care provision models on these visits.

Nevertheless, both studies have important strengths, since they use detailed and rich individual level data. The first used representative individual and household data from a large harmonized European survey from 28 countries, which allows for an international comparison of the effect of the Great Recession on access to primary care, which no other study provides to date; and the third used individual data on all patients who visited an emergency department in all public Portuguese NHS hospitals for the years 2013 to 2015, allowing us to describe for the first time the association between the different primary care provision models and secondary care use, as measured by the number of emergency department visits.

The second and fourth papers have the advantage of using long data series and data on all in-patient stays at all public non-specialized Portuguese NHS hospitals for the years 2000 to 2014 and 2015, respectively. The second paper provides an important insight to the persistent and rising socioeconomic inequalities in access to primary care and continuity of care in Portugal, and the fourth paper allows for an extensive analysis of the impact of the primary care reform on health outcomes, using a generalized difference-in-difference analysis, and contributes to the international literature of the

effect of pay-for-performance in primary care. On the downside, these studies rely on municipality-based socioeconomic variables, which could lead to ecological fallacy, that is, a fallacy inherent to making causal inferences from group data and applying those inferences to individuals.[193] Therefore, the observed associations at the municipality level might not be reflected at the individual level since the correlation coefficient between the group-level variables is generally not the same as that between those same variables at individual-level. Nonetheless, it is also not true that the individual-level models are always more perfectly specified than ecological-level models.[193]

Finally, it is important to note that all studies analyzed the effectiveness of primary care using indirect measures, namely ACSC and emergency department visits, or subjective measures such as self-reported access. All of these variables likely reflect the effectiveness and quality of primary care, but are not sufficiently informative, for example, regarding the number of times people did not access primary care, the reasons why primary care was not accessible, or the specific reasons why or if there was a deficiency in continuity of care, coordination of care, or in comprehensiveness. Nevertheless, this dissertation demonstrates that by using these measures, important and relevant conclusions can be drawn regarding the effect of contextual, health system, and individual characteristics on inequalities in access and continuity of care in primary care.

5.3. Future research

During the elaboration of this dissertation, some research questions beyond those proposed at the beginning arose that deserve to be investigated in the future. First, primary care non-utilization and reason(s) for it should be explored. In the first paper the self-reported access to primary care was evaluated among those persons who actually use primary care services, since in the European Statistics on Income and Living Conditions questionnaire only those individuals who use primary care services actually rated the difficulty in access. Consequently, the issue of primary care non-utilization is not addressed. Even though the non-users represented only 1.6% of the sample, in some countries, such as Portugal, this percentage is substantial, and actually is the highest among all countries: 32.8% in 2007 and 11.2% in 2012. The non-utilization of primary care services may be due to choice (e.g. people with high socioeconomic status who use specialized private care), or due to an inability to use (e.g. very low socioeconomic status people who face major access barriers; or people without a designated general practitioner). Additionally, the non-utilization of health services may not be a function of individual choice, since due to a lack of education or of culturally acceptable services, some choices are not informed.[125] Understanding the reasons for non-utilization could support primary care oriented policies and eventually lead to a reduction of inequalities in the use of and access to primary care. In the same line, more research should be devoted to understanding the reasons for hindered access; conclusions may be very different if these limitations are due to financial conditions or to lack of primary care services in the residence area.

Second, further research should be developed in order to understand why individuals from low socioeconomic areas are more likely to be hospitalized for avoidable reasons, and how the quality of preventive and primary care services influences ACSC. There are several possible explanations derived from the literature related to: individual factors, such as poorer understanding of physician´s recommendations, poorer treatment compliance, financial constraints, or the propensity to visit (or not) a primary care physician according to self-perceived needs and perceptions of the benefits and quality of care;[35,48–50] and to contextual factors such as lower overall investment in primary care and quality of care in more deprived areas.[38,39] Understanding the specific mechanisms for the socioeconomic inequalities in ACSC in Portugal may contribute to the development and implementation of effective health policies toward reducing the current inequalities and their associated costs. Again, this would require the collection of more detailed data, and the performance of studies of a more qualitative nature.

Third, the inadequate emergency department visits should be quantified, i.e. those emergency department visits that are classified as non-urgent based on the Manchester Triage System, and their reason should be explored. For the elaboration of the third paper, data on the Manchester Triage System were not available and therefore it was not possible to explore the emergency department visits that do not correspond to actual emergencies. However, due to the excessive use of emergency department in Portugal,[27] and some evidence that points to patient behavior as one of the main reasons for inadequate emergency department visits,[89,153,154] this research question should be pursued and the underlying reason for this behavior should be explored. As mentioned above, the availability of primary care does not necessarily mean that all people will preferably use primary care services as a first contact with the health system, despite having good access. The acceptability of primary care services, which includes the previous experiences and satisfaction with the organization of primary care, will also contribute to the actual utilization of primary care services.[35] Some evidence points to the telephone triage systems as an intervention to reduce inappropriate emergency department visits, while case-management might help reduce the number of emergency department attendances by frequent users.[78]

Fourth, the effectiveness of pay-for-performance in primary care in Portugal should be measured on health outcomes related to the incentivized indicators that were not included in the fourth paper, i.e. related to child and maternal health, cancer screening, and vaccination. The fourth paper focused on only some of the conditions included in the pay-for-performance scheme, those that are ambulatory care sensitive (based on the set of guidelines for the adult population as defined by the Agency for Healthcare Research and Quality[57]) and should lead to a reduction in hospital admissions and to an overall healthier status of the patient due to better disease management. The other performance indicators incentivized under the pay-for-performance scheme were not included in this analysis and therefore the effect of pay-for-performance on health outcomes related to those conditions should be explored. This could provide additional insights about the adequacy of the pay-for-performance scheme in primary care. In addition, it would be valuable to examine indicators not included in the pay-for-performance scheme in order to detect if there were crowding-out or spillover effects to non-incentivized areas.

Last, an evaluation from a cost-effectiveness (or cost-consequence) perspective of the Portuguese primary care reform should be pursued, in order to assess whether the health gains justified the reform´s investment. The Portuguese primary care reform

represented a substantial financial investment with the creation of new primary care provision models, namely FHUs, which involved different payments of professionals (through pay-for-performance), and renovation or replacement of infrastructures and equipment. This highlights the need to evaluate if these investments justify the health outcomes gained, from a cost-effectiveness perspective. Results from the third and fourth papers show that people assigned to FHUs have fewer emergency department visits, but no effect was found on the rate of ACSC. Other measures that express secondary care use such as number of specialist referrals, and health outcomes such as asthma prevalence, diabetes prevalence, self-rated health, and potential years of life lost could be explored.[11] Part of this research has already been performed, which was not sufficiently developed to be included in the present dissertation, but which is briefly presented below.

5.3.1. Ongoing research on expenditures in Portuguese primary care

Regarding the cost evaluation, some preliminary analysis was already performed that provides an insight of the expenditures of the three primary care provision models in Portugal: PHCU, FHU model A (FHU-A), and FHU model B (FHU-B). Data on the number of registered patients and number of primary care users as well as data on expenditures on medicines, diagnostic tests, and human resources, were obtained for 796 primary care units (363 PHCU, 241 FHU-A, and 192 FHU-B) for the year 2015[4], and the total mean expenditures per primary care unit and per user were calculated. The main results of this analysis are presented below:

- In 2015 the total mean expenditure of an FHU-B was 2,036,812€, followed by the PHCU and FHU-A with a mean expenditure of 1,685,259€ and 1,514,773€ per unit, respectively.
- In 2015 the PHCU had on average 12,077 registered patients, of which 7,533 were users. The FHU-A had on average 10,553 registered patients, of which 7,105 were users, and finally, the FHU-B had, on average 13,681 registered patients, of which 9,895 were users. Thus, the differences in total expenditures may not be related only

[4] Data were obtained by the Portuguese Central Administration of the Health System according to the research protocol celebrated with the Escola Nacional de Saúde Pública da Universidade NOVA de Lisboa for the study *"Avaliação da reforma dos Cuidados de Saúde Primários centrada nos ganhos de economia, eficiência e eficácia resultantes da transformação de UCSP em USF"*.

to differences in the expenditures per registered patient, but also to differences in the number of actual users, which is related to the access to primary care.

- Consequently, the mean expenditure by user was 230.2€ in PHCU, 214.5€ in FHU-A, and 203.4€ in FHU-B. The difference in expenditures between the PHCU and FHU-A was essentially related to a lower expenditure in medicines in FHU-A in comparison to PHCU (93.4€ *vs.* 103.9€).

Based on these results, a multivariate analysis was performed of the total expenditure per primary care unit based on the number of users and the type of primary care unit (with the PHCU as reference). Additionally, a multivariate analysis of the total expenditure by user based on the type of primary care unit was also performed. Both regressions were adjusted by the socioeconomic characteristics of the population from the geographical area under influence of each primary care unit (parish/municipality), available at the National Institute for Statistics.[93] Results of the multivariate analysis are presented below:

- Regarding the total expenditures by primary care unit, results show that FHU-A had a significantly lower total expenditure of 53,056€ compared to the PHCU, and the FHU-B had a significantly lower total expenditure of 85,361€ in comparison to the FHU-A.
- Regarding the total expenditures by user, results also show a lower expenditure in FHU-B (209€) as compared with PHCU (225€) and FHU-A (217€).

Finally, a potential impact in terms of expenditures was estimated for the hypothetical transition of the primary care units from PHCU to FHU-A, and from FHU-A to FHU-B. This potential impact was estimated in two steps, based on the following assumptions: first, there would be a potential saving, since PHCU are costlier than FHU-A, and FHU-A are costlier than FHU-B; second, there would be a potential expenditure increase due to the increase in the number of users in FHU-A and FHU-B. In 2015, the utilization rate was 62.5% in PHCU, 67.9% in FHU-A, and 73.4% in FHU-B. This higher utilization is assumed to be due to the underlying characteristics of FHU: better and faster access to primary care. Based on these two assumptions, the potential savings and expenses were calculated as follows:

- On one hand, if all PHCU transited to FHU-A, the difference between the total predicted expenditure of PHCU (based on the predicted margins) and the real mean expenditure of PHCU would be 49,066€. By multiplying this value by the 389 PHCU in 2015, a total hypothetical saving of 19.1 million euros would be obtained. On the other hand, FHU-A have a utilization rate of 67.9% in comparison to 62.5% in PHCU, and it is therefore expected that the number of users would increase in PHCU if they transited to FHU-A. Based on this assumption, the total of "new" users was calculated by artificially increasing the utilization rate of PHCU from 62.5% to 67.9%, i.e. 252,619 users. Taking into account the cost per user of FHU-A (217€), a total of 54.8 million euros of additional expenses could be expected.
- The same rationale was performed if all FHU-A were to transit to FHU-B. Thus, on one hand, the difference between the total predicted expenditure of FHU-A (based on the predicted margins) and the real mean expenditure of FHU-A would be 69,024€. By multiplying this value by the 241 FHU-As in 2015, a total hypothetical saving of 16.6 million euros would be obtained. On the other hand, FHU-B have a utilization rate of 73.4% in comparison to 67.9% in FHU-A, and it is therefore expected that the number of users would increase in FHU-A if they transited to FHU-B. Based on this assumption, the total of "new" users was calculated by artificially increasing the utilization rate of FHU-A from 67.9% to 73.4%, i.e. 138,924 users. Taking into account the cost per user of FHU-B (209€), a total of 29.0 million euros of additional expenses could be expected.

These results, which suggest a higher expenditure of FHU-A in comparison to PHCU, and of FHU-B in comparison to FHU-A, must be interpreted with caution, since both potential savings and additional expenses represent a maximum saving threshold. Of special note, it is unlikely that the utilization rate would increase so substantially. Also, the expenditures were adjusted only by the population characteristics of the geographical area under the influence of each primary care unit, and not by the "real" characteristics of the people who actually use primary care. Thus, a part of the expenses might be explained by unobserved differences in clinical and socioeconomic characteristics of the users.

In conclusion, these preliminary results characterize the mean expenditures of the different primary care provision models and estimate, to some extent, the potential impact in terms of expenditures based on the hypothetical transition between the different primary care provision models. A more detailed analysis with more

disaggregated data and other items of expenditures should be performed, and the reason for the differences in expenditures between the primary care provision models should be explored.

6. Concluding remarks and policy implications

The findings of this dissertation reinforce the literature on the effectiveness of primary care as the key focal point of health systems and health care provision, and may contribute for the design and implementation of health policies.

First, this dissertation highlights that people living in countries with a strong primary care, measured by the higher supply of primary care physicians and overall higher investment in health care, have better access to primary care. In addition, it reinforces the need for investment in primary care, especially during economic crisis, since it was shown that access to primary care significantly improved for people living in countries with greater investment in health and primary care. These investments and policy measures may have provided some social and financial protection to the most vulnerable populations. Primary care is inherently a more equitable level of care provision, since it is less costly, more easily available to the patient, and focuses on the early detection and prevention of the progression of disease. Thus, continuous investments in primary care are more likely to have an impact in reducing disparities in the severity of illness, which is essential to lessen the disparities in health between the more and less socially deprived groups of population.[7,8]

Second, the present findings reinforce the need for the development of a nationally-oriented research strategy to implement public policies aiming to reduce social inequalities. Portugal has universal health coverage, is characterized by relatively low co-payment rates in primary care, has a large network of primary care practices, and has been undergoing a primary care reform with substantial public investments since 2006. Portugal is also characterized by having a relatively weak social welfare system and is one of the European Union countries with the greatest inequalities in income distribution and risk of poverty.[128] The persistent socioeconomic inequalities in health in Portugal[31] suggest that a strong and effective primary care system can contribute only partially to tackle these inequalities. It is known that a strong primary care can buffer the inverse association between income inequality and health,[13] but it is also known that strengthening the social welfare system and reducing income inequalities is likely to have a considerable impact in reducing health inequalities, as it mediates the social determinants of health.[19412] In fact, as Detollenaere et al. (2017, 2018) recommend, policymakers should attempt to eliminate income inequalities and not only focus on the strengthening of primary care, in order to reduce inequity in health.[12,13]

Third, the absence of a significant health effect of pay-for-performance in primary care, which is in line with previous literature, supports the need for the revision of the current pay-for-performance scheme in primary care in Portugal. There is a wide range of pay-for-performance schemes with varying incentive structures, purpose, targets, and context, but overall there is absence of strong evidence of benefits associated with pay-for-performance and there is no evidence regarding what the best incentive structure is.[46] In Portugal the performance indicators and the process of attribution of financial incentives have remained practically unchanged since their implementation in 2006. Therefore, at a time when a new contracting model for primary care is being developed, the timing for the adequacy of the pay-for-performance scheme is crucial. For example, Mendelson et al. (2017) suggest that the overall number of incentives in place at one time should be carefully considered, since there is evidence that the most considerable gains are consistently seen in areas of poor baseline performance. Thus, incentives should be assigned to the most-needed areas and should be regularly revised and discontinued after achieving sustained improvements.[46]

Also, it must be considered whether to reward absolute or relative changes in the performance and whether comparisons are made against one's peers or an individual's past performance.[171] For example, there is a great concern that pay-for-performance could exacerbate health inequalities if it is designed to reward the "highest achievers" using scarce resources that could have been invested in health providers serving disadvantaged patients.[195] Nonetheless, the major concern with pay-for-performance is the evidence that not only its characteristics (e.g. frequency, size, type of target), the organizational structure, and physician´s capabilities (e.g. practice type, physician demographics, baseline performance) may have an influence on the effectiveness of pay-for-performance, but also the patient characteristics such as age and socioeconomic status can determine the degree to which health care providers can effectively meet the targets in pay-for-performance.[195] There is evidence that patients with low socioeconomic status are associated with lower baseline quality performance and attenuated improvement over time. For example, it was found that patients´ lack of transportation, housing insecurity, and low income posed significant barriers to physician practices improving quality in response to pay-for-performance programs.[195]

Markovitz and Ryan (2017) argue that there is great evidence that much of the variation in pay-for-performance is due to factors over which the health practices have limited control, and that these sources of performance heterogeneity cannot be treated as modifiers of quality performance when they represent, in fact, confounders for quality

performance.[195] Therefore, physicians may try to avoid disadvantaged patients, especially if the pay-for-performance would reward patient health outcomes.

A possible recommendation could be to include some risk adjustment for socioeconomic conditions in the pay-for-performance schemes or to pay larger amounts to those practices that reach quality goals for disadvantaged patients.[195] Overall, as pointed out by Houle et al. (2012), the enthusiasm for pay-for-performance, as a means to achieve improvements in quality in health, is inconsistent with the amount and quality of current evidence about its effectiveness.[171] Furthermore, the costs and burden in constructing an “adequate” risk adjusted pay-for-performance scheme, as well as the opportunity cost in the reporting requirements associated with pay-for-performance, should also be carefully considered.[46]

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Appendices

Appendix I – Additional analysis for paper 1.

Individuals who do not use primary care services represent 1.6% (n=11,502) of the sample: n=6,566 in 2007 and n=4,937 in 2012. Except for Portugal, where the percentage of non-users was comparatively very high (32.8% in 2007 and 11.2% in 2012), the second highest value of non-users was 4.8% in Spain in 2007, and 9.0% in Finland in 2012. In five of the countries (Ireland, Iceland, Norway, Romania, and United Kingdom) this percentage was zero in both years.

In order to evaluate the potential bias due to non-users of primary care services in the self-reported access to primary care, we estimated the predicted probability of the use of primary care services for each individual using a probit regression. Then, we replicated the original logistic regression (Regression IV, Table A1) and modeled an additional regression weighting observations by the inverse predicted probability of being a primary care user, from the probit regression (Regression V, Table A1). We found no differences in the odds ratios between the two models, i.e. with and without sample weights.

Table A1. Logistic regression for the probability of reporting difficult access to primary care weighted for the probability of using primary care, between 2007 and 2012, in 28 European Countries

	Regression IV			Regression V (weighted for the probability of using primary care)		
Difficult access to primary care	OR	(95% CI)		OR	(95% CI)	
Year 2007	1			1		
Year 2012	0.94***	(0.93;	0.95)	0.93***	(0.92;	0.95)
Individual characteristics						
Age	1.00***	(1.00;	1.00)	1.00***	(1.00;	1.00)
Female	1			1		
Male	1.02***	(1.01;	1.04)	1.02***	(1.01;	1.04)
Not married	1			1		
Married	1.00	(0.99;	1.01)	1.00	(0.99;	1.01)
Country of birth (same as residence)	1			1		
Country of birth (any other EU country)	0.92***	(0.89;	0.96)	0.93***	(0.89;	0.97)
Country of birth (any other country)	0.75***	(0.73;	0.78)	0.75***	(0.73;	0.78)
Education (tertiary education)	1			1		
Secondary education	1.22***	(1.20;	1.24)	1.22***	(1.20;	1.24)
No education / primary education	1.65***	(1.61;	1.68)	1.64***	(1.61;	1.68)
No Deprivation	1			1		
Deprivation	1.20***	(1.18;	1.22)	1.20***	(1.18;	1.22)
Make ends meet (Easily or very easily)	1			1		
Fairly easily	1.33***	(1.30;	1.36)	1.33***	(1.30;	1.37)
With some difficulty	1.77***	(1.73;	1.81)	1.77***	(1.73;	1.81)
With difficulty or great difficulty	2.03***	(1.98;	2.08)	2.04***	(1.99;	2.09)
Self-reported health (Very good)	1			1		
Good	1.17***	(1.15;	1.20)	1.17***	(1.15;	1.20)
Fair	1.35***	(1.32;	1.38)	1.35***	(1.32;	1.38)
Bad or very bad	1.78***	(1.73;	1.84)	1.78***	(1.73;	1.83)
No chronic condition	1			1		
Chronic condition	0.95***	(0.94;	0.97)	0.95***	(0.94;	0.97)
Country level characteristics						
No gatekeeping	1			1		
Moderate gatekeeping	0.93***	(0.91;	0.94)	0.93***	(0.91;	0.95)
Fully enforced gatekeeping	0.93***	(0.91;	0.94)	0.93***	(0.91;	0.94)
Health expenditure	0.83***	(0.83;	0.84)	0.83***	(0.83;	0.84)
Rate of generalist medical practitioners	0.97***	(0.95;	0.98)	0.97***	(0.95;	0.98)

*** p<0.01; ** p<0.05; * p<0.1
OR – odds ratios
EU – European Union

Appendix II – Additional tables for paper 4.

Table A2. Incentivized indicators for the allocation of institutional (team-based) financial incentives at national level for FHU model A

Incentivized indicators for the allocation of institutional (team-based) incentives at national level for FHUs model A		
Year	**Number of indicators**	**Main area**
2006 to 2013	13	Access, utilization, patient satisfaction, costs Cancer screening, child health, maternal health, vaccination
	1	**Diabetes** "Percentage of diabetics with at least one glycosylated haemoglobin (HbA1c) test registered in the last three months/ at least three HbA1C registered in the last twelve months"
	1	**Hypertension** "Percentage of hypertensive patients with at least one registry of blood pressure in the last six months / each semester"
2014 to 2015	10	Access, utilization, patient satisfaction, costs Cancer screening, child health, maternal health, mental health
	1	**Diabetes** "Proportion of diabetic patients with at last one glycosylated haemoglobin (HbA1c) test registry <= 8,0%
	1	**Hypertension** "Proportion of hypertensive patients with less than 65 years of age with a registry of blood pressure < 150/90"

Notes: The performance indicators are defined at a national level and equal for all FHUs, only since 2014 each of the five Regional Health Administrations had the possibility of choosing two performance indicators to be included for the attribution of team-based institutional incentives at local level.[179]
The attribution of institutional incentives, until 2013, was performed as follows: each of the indicators was scored with three possible points (2, 1 or 0) based on their level of achieved performance (i.e. >90%; 80%-90%; or <80%). For a minimum score of 27 points (specifically distributed within the different main areas such as access, patient satisfaction, costs and care performance) the institutional incentives were attributed at 100%, and for a minimum score of 24 point the institutional incentives were

attributed at 50%. The maximum annual value per FHU is 20,000 €.[29] Since 2013, the attribution of institutional incentives is based on an overall Global Performance Index (*Índice de Desempenho Global),* in which each of the indicators has a specific weight. Consequently, the final score is now calculated based on the "weighted points". A FHU with a Global Performance Index < 75% is not eligible for the attribution of institutional incentives. The maximum annual value per FHU remains 20,000 €.[196]

Table A3. Incentivized indicators for the allocation of financial (individual-based) incentives at national level for FHU model B

Incentivized indicators for the allocation of financial (individual-based) incentives at national level for FHUs model B: for nurses and administrative technicians		
Year	**Number of indicators**	**Main area**
2009 to 2013	11	Cancer screening, child health, maternal health, vaccination
	3	**Diabetes** "Percentage of diabetic patients covered by the nursing consultation" "Percentage of diabetic patients with at least one foot exam registered in the last year" "Percentage of diabetic patients with a registry of the therapeutic regimen"
	3	**Hypertension** "Percentage of hypertensive patients with a registry of blood pressure every semester" "Percentage of hypertensive patients with at least one registry of Body Mass Index in the last 12 months" "Percentage of hypertensive patients with the tetanus vaccine updated"
2014 to 2015	12	Cancer screening, child health, maternal health, vaccination
	3	**Diabetes** "Percentage of diabetic patients covered by the nursing consultation in the last year" "Percentage of diabetic patients with at least one foot exam registered in the last year" "Percentage of diabetic patients covered by the nursing consultation and registry of the therapeutic regimen (3 items) in the last year"
	2	**Hypertension** "Percentage of hypertensive patients with a registry of blood pressure every semester"
		"Percentage of hypertensive patients with at least one registry of Body Mass Index in the last 12 months"

Incentivized indicators for the allocation of financial (individual-based) incentives at national level for FHUs model B: for General Practitioners		
Year	**Number of indicators**	**Main area**
2009 to 2015	16	Child health and maternal health
	7	**Diabetes** "A. Have the diagnosis of diabetes mellitus in the problem list, with active state." "B. Have had at least two medical consultations (direct contact) during the period under review with a parameterized record, with one of the ICPC2 headings that allow the surveillance of diabetes mellitus." "C. Have at least two blood pressure records during the reporting period." "D. Have at least two hemoglobin A1C result recordings performed during the analysis period." "E. Have at least one hemoglobin A1C result record <= 8.5% performed during the analysis period." "F. Have at least one microalbuminuria result record performed during the analysis period." "G. Have at least one record of total cholesterol, HDL cholesterol and triglycerides performed during the analysis period."
	6	**Hypertension** "A. Have the diagnosis of hypertension on the problem list with active status." "B. Have had at least two medical consultations (direct contact) during the period under review with a parameterized entry under one of the ICPC2 headings that allow the surveillance of hypertension to be coded." "C. Have at least two blood pressure records during the reporting period." "D. Have at least one blood pressure record during the analysis period with SBP values <= 150 mmHg and DBP <= 90 mmHg." "E. Have at least one microalbuminuria result record performed during the analysis period." "F. Have at least one record of total cholesterol, HDL cholesterol and triglycerides performed during the 24 months preceding the end date of the period under review."

Notes: The attribution of financial incentives for nurses and administrative technicians is performed as follows: each of the 17 indicators is scored with three possible points (2, 1 or 0) based on their level of achieved performance (i.e. >90%; 80%-90%; or <80%). For a minimum score of 30 points, the financial incentives are attributed at 100%, and for a minimum score of 25 points the financial incentives are attributed at 50%. The maximum annual value for nurses is 3,600€, and 1,150€ for administrative technicians.[29] There were no changes in the metrics for the attribution of financial (individual-based) incentives in 2013, as opposed to the institutional (team-based) financial incentives.[196] The attribution of financial incentives for GPs is performed as follows: a patient is counted in the incentive scheme if he/she fulfils all requirements (A, B, C, D …) set in the indicators: for example, a patient counts if he/she is diagnosed with hypertension, had at least two medical appointments, had two registers of

blood pressure, had at least one register of blood pressure registry < 150/90, had at least one test of microalbuminuria, and had at least one cholesterol test (total, HDL and triglycerides), over the period. The number of counted patients (patients who fulfil all requirements) is then translated into a score, where around 55 patients value one point, being the point awarded with a monetary benefit (130 euros per point).[197] The maximum value for GPs is not available in decree law, but it may reach up to 30% of total GPs remuneration.[27]